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PROCEEDINGS

OF THE

American Forestry Association



AT THE

Fifteenth Annual Meeting,

Washington, February 5th, 1897,

Being the First Meeting After Incorporation.

VOLUME XII.

WASHINGTON, D. C. :
1897.



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NOTICE.

The proceedings of the American Forestry Association have hitherto been published irregularly, the volumes not being numbered. With the improved financial condition of the Association, and its increased membership, a regular issue of the annual proceedings in future appears warranted, and it seems desirable to designate, by numbers, not only the coming volumes but also those previously issued. The present volume is, therefore, numbered XII. The series of previous volumes includes the following publications. Of these, those marked * are out of print:

- 50
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- *Vol. I.—Proceedings of the special meeting at Montreal, August, 1882. Papers read before the meeting printed separately by the Canadian Government in the Ontario Fruit Growers' Report. (The proceedings of the first annual meeting, that held at Cincinnati, April 25-29, 1882, were not published in pamphlet form).
 - *Vol. II.—Proceedings of the second annual meeting, at St. Paul, August, 1883. Also, Forestry Bulletins No. 1 (May, 1884); No. 2 (September, 1884); No. 3 (January, 1885).
 - *Vol. III.—Proceedings of the special meeting at Washington, D. C., May, 1884, and third annual meeting, at Saratoga, New York, September, 1884.
 - *Vol. IV.—Proceedings of the fourth annual meeting, held at Boston, September, 1885.
 - *Vol. V.—Proceedings of the fifth annual meeting, held at Denver, Colorado, September, 1886. (Newspaper report.)
 - *Vol. VI.—Proceedings of the sixth annual meeting, held in Springfield, Illinois, September, 1887.
 - Vol. VII.—Proceedings of the seventh annual meeting, held at Atlanta, Ga., December, 1888, and of the eighth annual meeting, held at Philadelphia, Pa., October, 1889. (About 70 copies on hand.)
 - Vol. VIII.—Proceedings of the summer meeting, held in Quebec, September, 1890, and of the ninth annual meeting, held in Washington, D. C., December, 1890. (About 400 copies on hand.)
 - Vol. IX.—Papers read at joint session of the American Economic Association and the American Forestry Association, held at Washington, D. C., December, 1890.
 - Vol. X.—Proceedings at the tenth, eleventh, and twelfth annual meetings, held in 1891, 1892 and 1893, and of the special meeting at the World's Fair Congress in Chicago in 1893. (Published in four parts. Of these there are on hand, Part 1, 400 copies; Part 2, 1,700 copies; Part 3, 1,400 copies; Part 4, 1,300 copies.)
 - Vol. XI.—Proceedings at the Thirteenth and Fourteenth Annual Meetings, December, 1894, and January, 1896, at Washington, and at the summer meetings at Brooklyn, N. Y., and Springfield, Mass. (Published in three parts. Of these there are on hand: Part 1, 1,100 copies; Part 2, 1,400 copies; and Part 3, 1,800 copies.)

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Brown, Geo. H.....	48 West 59th St., New York.
Brundage, A. H.....	1153 Gates Ave., Brooklyn.
Brooks, Thomas Benton.....	Newburgh.
Bryce, Miss Edith.....	40 West 54th St., New York.
Burden, Henry, 2d.....	Cazenovia.
Burke, Dr. Martin.....	147 Lexington Ave., New York.
Butler, Miss Rosalie.....	31 East 69th St., New York.

NEW YORK.—*Continued.*

- Chichester, Charles F. 33 East 17th St., New York.
 Child, Addison. Childwood.
 Choate, Miss Josephine. 50 West 47th St., New York.
 Claflin, John. Pres. H. B. Claflin Co., New York.
 Cogswell, Wm. B. Syracuse.
 Cook, Martin R. 146 Franklin St., New York.
 Craig, Moses. 122 Lyell Ave., Rochester.
 Crary, J. D. 18 Broadway, New York.
 Cutting, W. Bayard. Room 516, 32 Nassau St., New York.
 deCamp, Wm. S. 35 Mt. Morris Ave., New York.
 Dietrich, C. F. 45 Broadway, New York.
 Dodge, Geo. E. 45 Broadway, New York.
 Dodge, D. Steuart. 11 Cliff St., New York.
 *Dolge, Alfred. Dolgeville.
 Dowd, Olney B. 155 So. 1st Ave., Mount Vernon.
 *Dudley, P. H. 80 Pine St., New York.
 Edmonds, Walter D. 31 Nassau St., New York.
 Egan, John. 439 West 14th St., New York.
 Egerton, Wm. S. Albany.
 Faile, Thomas H. 45 South St., New York.
 Fairchild, Hon. Charles S. 76 Clinton Place, New York.
 Ferguson, Wm. E. 127 Produce Exchange, New York.
 *Flower, Hon. Roswell P. 52 Broadway, New York.
 Foord, John. 128 East 34th St., New York.
 Foot, James D. 269 Lexington Ave., New York.
 Fox, Wm. F. Forest Commission, 342 Hudson St., Albany.
 Gerhard, Wm. Paul. 36 Union Square, New York.
 Greiffenberg, Frederick. 2622 3rd Ave. and 141st St., New York.
 Hamilton, Arthur S. Rochester.
 Harper, Henry S. Franklin Square, New York.
 Harris, Frederick. Albany.
 Herrman, Mrs. Esther. 59 West 56th St., New York.
 *Hicks, John S. Roslyn, Queens Co.
 Higley, Hon. Warren. 32 Nassau St., New York.
 Higley, Mrs. Warren. 68 W. 40th St., New York.
 Hildenbrand, Wilhelm. 1 Broadway, New York.
 Hoe, Mrs. Richard M. 11 East 71st St., New York.
 Hofferberth, Charles F. 540 W. 22nd St., New York.
 Hough, Romeyn B. Lowville.
 Howard, Rev. Geo. A. Catskill.
 Hubbard, Robert J. Cazenovia.
 James, Dr. Walter B. 268 Madison Ave., New York.
 Jaques, William H. 30 West 73d St., New York.
 Jenkins, M. C. 143 Liberty St., New York.
 Jennings, Miss A. B. 48 Park Ave., New York.
 Jennings, Walter. 11 East 41st St., New York.
 *Jesup, Morris K. 52 William St., New York.
 Johnson, Frank E. Sub-Station 58, Brooklyn.
 Johnson, R. U. Century Magazine, New York.

NEW YORK.--*Continued.*

- Jones, Bassett..... 75 West 92nd St., New York.
 Jones, Miss Caroline Ogden.. 293 Madison Ave., New York.
 Kelsey, Fred. W..... 150 Broadway, New York.
 Kenyon, W. W..... Smithtown Branch, L. I.
 Kilduff, Thomas H..... 115 Broadway, New York.
 King, Hon. John A..... Great Neck, Long Island.
 King, John S..... 238 Williams St., New York.
 Kitching, Frank W..... 55 Dey St., New York.
 Kunz, Geo. F..... 11 and 15 Union Square, New York.
 Leggett, Francis H..... 6 West 43rd St., New York.
 MacNaughton, James..... 86 State St., Albany.
 Marie, Peter..... 48 West 19th St., New York.
 Marston, Edwin S..... 217 Clinton Ave., Brooklyn.
 Martin, Edmund P..... Cor. Pearl and Pine Sts., New York.
 Meeker, Stephen J..... 95 Clay St., New York.
 Meredith, Eugene S. T..... Syracuse.
 *Mills, A. G..... 38 Park Row, New York.
 *Mills, D. O..... Mills Building, New York.
 Muller, L. G..... 1 Broadway, New York.
 McCreedy, C. O..... Ballston Spa.
 Nasl, Francis Philip, Jr..... Geneva.
 Peabody, Prof. Geo. L..... 57 West 38th St., New York.
 Peck, Prof. Chas. H..... Botanist, State Hall, Albany.
 Pinchot, Gifford..... 2 Gramercy Park, New York.
 Pittinger, James H..... Carroll St., Brooklyn.
 Powell, Geo. T..... Ghent.
 Pruyn, Robert C..... 38 State St., Albany.
 Raymond, Rossiter W..... 13 Burling Slip, New York.
 Satterlee, Mrs. Clarence..... 102 East 31st St., New York.
 Schofield, Peter F..... Box 2951, New York.
 *See, Mrs. Horace..... 40 West 9th St., New York.
 Segar, Anson G. P..... Hotel St. George, Brooklyn.
 Shearman, Thomas G..... 176 Columbia Heights, Brooklyn.
 Smith, Hugh Montg. M. D... 78 Orange St., Brooklyn.
 Smythe, C. H., Jr..... Clinton.
 Soper, A. W..... 160 Broadway, New York.
 Spencer, Mrs. Lorillard..... 107 East 17th St., New York.
 Spencer, Samuel..... 80 Broadway, New York.
 *Stephens, W. Hudson..... Lowville.
 Stimpson, Henry L..... 32 Liberty St., New York.
 Stoddard, S. R..... Glens Falls.
 Stowell, Thomas B..... Potsdam.
 Thacher, Dr. Johns..... 33 W. 39th St., New York.
 *Thayer, Dr. Wm. A..... Cooperstown.
 Thompson, Sidney De C..... Corn Exchange Bank Bldg., New York.
 Tratman, E. E. Russell..... 1037 Tribune Building, New York.
 Tuckerman, Paul..... Tuxedo.
 *Vanderbilt, George W..... 640 Fifth Ave., New York.
 Vanderbilt & Hopkins..... 126 Liberty St., New York.

NEW YORK.—*Continued.*

Wadsworth, W. Austin.....	Geneseo.
Walker, Alfred.....	43 Liberty St., New York.
Ward, Dr. Samuel B.....	135 North Pearl St., Albany.
Warren, Miss Mary B.....	19 2nd St., Troy.
Wetmore, Jacob S.....	No. 2 Wall St., New York.
Williams, Richard R.....	124 St. James Place, Brooklyn.
Worman, J. H.....	Ed.-in-Chief "Outing," 239 Fifth Ave.

NORTH CAROLINA.

Ashe, W. W.....	Raleigh.
Griffith, Edward M.....	Biltmore.
Holmes, Prof. J. A.....	State Geologist, Raleigh.
Price, Overton Westfeldt.....	Biltmore Estate, Biltmore.
Schenck, C. Alwin.....	Biltmore.

NORTH DAKOTA.*

Barrett, W. W.....	Church's Ferry.
Brown, C. G.....	Minnewaukon, Benson Co.
Carrick, G. M.....	Minto, Walsh Co.
Cornish, R. N.....	Gillette.
Haynes, L. H.....	Fargo.

OHIO.

*Bambach, George.....	Ripley.
Brower, Abraham.....	Fernbank.
Brown, Miss Anne F.....	North Bloomfield.
Brown, Fayette.....	Euclid Ave., Cleveland.
Canfield, Pres. James H.....	State University, Columbus.
Chambers, D. B.....	Stewart Iron Co., Cleveland.
Eckley, Sidney.....	331 Middle St., Dayton.
*Fisher, W. Hubbell.....	Cincinnati.
Gamble, James N.....	Carew Building, Cincinnati.
Gano, John A.....	College Hill, Cincinnati.
Garrard, Jephtha.....	44 Johnson Bldg., Cincinnati.
Holloway, C. M.....	53 Vine St., Cincinnati.
Ingalls, M. E.....	Pres. C. C. C. & St. L. R. R., Cincinnati.
*Lazenby, Prof. Wm. R.....	State University, Columbus.
Marvin, A. J.....	Wiltshire Building, Cleveland.
Mather, Wm. G.....	Pres. Cleveland-Cliffs Iron Co., Cleveland.
Poindexter, Rev. James.....	41 North 4th St., Columbus.
*Read, Prof. Matthew C.....	Hudson.

PENNSYLVANIA.—*Continued.*

Fisher, Geo. H.....	308 Walnut St., Philadelphia.
Fisher, Mrs. Geo. H.....	308 Walnut St., Philadelphia.
Fisher, Dr. Henry M.....	317 So. 12th St., Philadelphia.
Fox, Joseph M.....	221 South 5th St., Philadelphia.
Grant, J. Blackwood.....	Douglassville, Berks Co.
Griscom, Clement A.....	Haverford.
Haines, Francis C.....	Haines St., Germantown, Philadelphia.
Haseltine, Frank.....	1825 Walnut St., Philadelphia.
*Haydon, James C.....	Jeanesville, Luzerne Co.
Heston, Mrs. Geo. T.....	Newtown.
Hutchinson, Pemberton S.....	112 Chestnut St., Philadelphia.
James, H. F.....	Franklin.
Jayne, H. La Barre.....	505 Chestnut St., Philadelphia.
Jenks, John Story.....	1937 Arch St., Philadelphia.
Kreuzpaintner, Paul.....	1400 3d Ave., Altoona.
Lansdale, W. Moylan.....	709 Walnut St., Philadelphia.
Landreth, Burnet.....	Bristol.
*Lea, Henry Charles.....	2000 Walnut St., Philadelphia.
Lundy, Mrs. Mary S.....	245 South 18th St., Philadelphia.
Maurice, C. S.....	1715 Walnut St., Philadelphia.
Montgomery, Dr. E. E.....	1818 Arch St., Philadelphia.
Paul, J. Rodman.....	505 Chestnut St., Philadelphia.
*Peabody, Chas B.....	1415 Spruce St., Philadelphia.
Porter, Prof. Thomas C.....	Lafayette College, Easton.
Rothrock, Dr. J. T.....	West Chester.
Ryman, Theodore.....	So. Franklin St., Wilkes Barre.
Snyder, Geo. D.....	City Engineer, Williamsport.
Spicer, A. R.....	Hoytville.
Stewardson, Thomas.....	Montgomery Ave., Chestnut Hill, Phila.
Van Sant, Miss Belle.....	Newtown, Bucks Co.
Vaux, J. W.....	505 Chestnut St., Philadelphia.
Walker, William.....	45 So. 3rd St., Allegheny.
Welsh, Herbert.....	1305 Arch St., Philadelphia.
Wilmsen, Bernhard.....	413 Commerce St., Philadelphia.
Wood, Stuart.....	400 Chestnut St., Philadelphia.
Zimmerman, Dr. M. W.....	1633 Chestnut St., Philadelphia.

RHODE ISLAND.

Andrews, Mrs. A. L.....	The Reef, Newport.
Davis, Theo. M.....	Newport.
Brown, John Nicholas.....	50 So. Main St., Providence.
Emmons, Arthur B.....	Newport.
Mason, Miss Ida M.....	Rhode Island Ave., Newport.
Russell, Henry G.....	East Greenwich.
*Wetmore, Geo. Peabody....	Newport.

SOUTH CAROLINA.

Green, Prof. H. A.....	Chester.
McKie, Dr. Thomas J.....	Woodlawn.

SOUTH DAKOTA.

Griffiths, David..... Aberdeen.
 McLouth, Dr. L..... Agr'l College, Brookings.

TENNESSEE.

Callender, Dr. John H..... Nashville.
 Goulding, B. L Chattanooga.
 Wright, Thomas T..... Nashville.

TEXAS.

Cline, Dr. Isaac M..... Weather Bureau, Galveston.
 Jones, W. Goodrich..... Pres. Temple Nat. Bank, Temple.
 Koppel, Mrs. I..... 24th St. and Broadway, Galveston.
 Marshall, W. S..... Box 404, Fort Worth.
 Montgomery, R. E..... Forth Worth.

UTAH.

Cannon, Geo. Q..... Salt Lake.
 Foster, Prof. Luther..... Logan.
 Park, Prof. John R..... Salt Lake.
 Paul, Prof. J. H..... Agricultural College, Logan.
 Rognon, Ernest G..... 305 Atlas Block, Salt Lake City.
 Whiting, Prof. C. A..... University of Utah, Salt Lake.

VERMONT.

Cannon, Le Grand B..... Burlington.
 Fairbanks, Mrs. Mary E..... St. Johnsbury.
 Fuller, Levi K..... Brattleboro.
 Grout, W. W..... Barton.
 Lawton, Dr. S. E..... 75 Linden St., Brattleboro.
 Piper, Nelson G..... Proctorsville.
 Proctor, Hon. Redfield..... Proctor.
 Titcomb, John W..... St. Johnsbury.

VIRGINIA.

Nourse, D. O..... Blacksburg.

WASHINGTON.

Lesh, Daniel E..... North Yakima.
 Meany, Edmond S..... University of Washington, Seattle.
 Newell, Bernice E..... 303 G St., Tacoma.
 Page, Miss Anne..... Buckley.
 Scudder, H. B..... North Yakima.

WEST VIRGINIA.

Corbett, Prof. L. C..... Morgantown.
 Hopkins, Prof. A. D..... Morgantown.

WISCONSIN.

Adams, Pres. Charles K..... Madison.
 Putnam, H. C..... Eau Claire.
 Ripley, L. V..... Eau Claire.
 Schinke, Max G..... Asst. City Engineer, Milwaukee.
 Starr, Wm. J..... Eau Claire.
 Swift, Elijah..... Eau Claire.
 Upham, W. H..... Marshfield.
 Weyerhauser, Fred..... Chippewa Falls.

- WYOMING.

Mead, Elwood..... Cheyenne.

CANADA.

Aberdeen, His Excellency the
 Earl of..... Government House, Ottawa.
 Allan, George William..... Imperial Bank Bldg, Toronto.
 Boyd, M. M..... Bobcageon.
 Campbell, Archibald..... Quebec.
 Chapais, J. C..... St. Denis, Kanawaska Co., Quebec.
 Craig, John..... Central Expt. Farm. Ottawa.
 Crown Lands, Department of.. Quebec.
 *Denton, John M..... London, Ont.
 *Drummond, Andrew T..... 265 University St., Montreal.
 Gibson, J. M..... Ontario Dept. of Crown Lands, Toronto.
 Heneker, R. W..... Sherbroke, Quebec.

*Joly de Lotbiniere, Sir H. G.. Point Platon, Quebec.
 Kirkwood, Alexander..... Crown Lands Office, Toronto.
 Little, William..... 404 Board of Trade, Montreal, Quebec.
 Macauley, Thomas B..... Westmount, Montreal.
 Robitaille, L. A..... Box 652, Quebec.
 Saunders, Prof. Wm..... Experimental Station, Ottawa.
 Shanley, Walter..... Montreal.
 Southworth, Thomas..... Parliament Building, Toronto, Ont.
 Turner, Richard..... Quebec.

MEXICO.

Leal,, Manuel Fernandez..... Secretary of Fomento, Mexico.

ARTICLES OF INCORPORATION

OF THE

AMERICAN FORESTRY ASSOCIATION.

Whereas, at a meeting of the AMERICAN FORESTRY ASSOCIATION, (a voluntary association organized in the City of Cincinnati and State of Ohio in 1882), duly called and held on the 20th day of December, A. D. 1892, it was:

Resolved, That the resident members of the Executive Committee of this Association in the City of Washington, District of Columbia, be, and hereby are, constituted a committee with full power to take all action which they may consider necessary to become a body corporate under and by virtue of the Acts of Congress relating to the District of Columbia in such case made and provided:

NOW THEREFORE, by virtue of and in pursuance with the foregoing resolution and the action of the said committee, duly had in that behalf:

Know All Men by These Presents: That we, the undersigned, each of whom is over twenty-one years of age and a citizen of the United States, and a majority of whom are citizens of the District of Columbia, being desirous of associating ourselves and those associated with us as aforesaid, for the purpose of converting the American Forestry Association into a body corporate in accordance with the Acts of Congress relating to the District of Columbia in such cases made and provided, do hereby certify as follows.

First. The name or title by which this corporation shall be known in law shall be "The American Forestry Association."

Second. That the term for which it is organized is twenty (20) years.

Third. That the objects of the organization are the discussion of subjects relating to tree-planting, the conservation, management, and renewal of forests, and the climatic and other influences that affect their welfare; the collection of forest statistics, and the advancement of educational, legislative, or other measures tending to the promotion of these objects. It shall especially endeavor to centralize the work done and diffuse the knowledge gained.

Fourth. That the number of Directors of this organization for the first year shall be seven.

IN TESTIMONY WHEREOF we have severally set our hands and seals, this 25th day of January, 1897.

EDWARD A. BOWERS,
GARDINER G. HUBBARD,
JOS. C. HORNBLLOWER,
BERNARD E. FERNOW,
NATHANIEL WILSON,
GEO. P. WHITTLESEY,
SAM. MADDOX.

District of Columbia, ss:

I, Frank D. Blackistone, a Notary Public in and for the District of Columbia, do hereby certify that on this 25th day of January, A. D. 1897, before me personally appeared, Edward A. Bowers, Gardner G. Hubbard, Joseph C. Hornblower, Bernard E. Fernow, Nathaniel Wilson, Geo. P. Whittlesey and Samuel Maddox, to me personally well known and known to me to be the persons whose names are signed to the foregoing and annexed certificate of incorporation, and did severally acknowledge the same to be their act and deed, and that they and each of them executed the same for the purposes therein set forth.

IN TESTIMONY WHEREOF I have hereunto set my hand and affixed my official seal, this 25th day of January, A. D. 1897.

[.....]
[SEAL.]
[.....]

FRANK D. BLACKISTONE,
Notary Public for the District of Columbia.

CONSTITUTION.

(Adopted February 5, 1897.)

ARTICLE I.

Name.

The name of this association shall be "The American Forestry Association."

ARTICLE II.

Objects.

The objects of this association shall be the discussion of subjects relating to tree-planting, the conservation, management and renewal of forests, and the climatic and other influences that affect their welfare; the collection of forest statistics; and the advancement of educational, legislative, or other measures tending to the promotion of these objects. It shall especially endeavor to centralize the work done and diffuse the knowledge gained.

ARTICLE III.

Members.

Section 1. Any person may become a member of this Association, as hereinafter provided.

Sec. 2. Members shall be divided into five classes: Patrons, Life Members, Active Members, Associate Members, and Honorary Members.

Sec. 3. Any person contributing at one time the sum of one hundred dollars (\$100) to the permanent fund of the Association shall be a patron. Any person may become a Life Member by the payment of fifty dollars (\$50) at one time. Patrons and Life Members shall not be liable for annual dues. Active members are those who pay the annual dues of two dollars (\$2). Associate members are the members of any local Forestry Association which shall vote to affiliate itself with the American Forestry Association, under such rules as the Executive Committee may adopt. Honorary members shall be the officers of State, Territorial, Provincial, or other forestry associations, or the delegates from such associations, or the delegates of any Government.

Sec. 4. Applications for membership shall be referred to and voted upon by the Executive Committee at any regular or called meeting therefor.

Sec. 5. All members except Associate and Honorary members shall be members of this corporation, and shall be entitled to vote and hold office in said corporation.

ARTICLE IV.

Officers.

Sec. 1. The officers of this Association shall be a Board of Directors, a President, a Vice-President for each State, Territory and Province represented in the Association, a Treasurer, a Recording Secretary, a Corresponding Secretary, and an Executive Committee.

Sec. 2. These officers shall be elected by ballot at the annual meeting of the Association, and shall serve one year, or until their successors are elected. Vacancies occurring during the year may be filled by the Board of Directors.

ARTICLE V.

The Board of Directors.

The Board of Directors shall have the control and management of the funds and property of the Association. The Board shall consist of seven (7) members, and shall elect its own President and Secretary. The latter shall have the custody of the corporate seal. The Board shall have power to fill any vacancy occurring therein, the appointee to serve until the next annual meeting. The Board shall take, receive, hold and convey such real and personal estate as may become the property of the Association for the purposes of the Association set forth in the certificate of incorporation and in Article II. above. A majority of the Board shall be a quorum. The Board shall meet one-half hour before the annual meeting of the Association, and at such other time as it may be called together by its President.

ARTICLE VI.

The President.

The President shall preside at all meetings of the Association.

ARTICLE VII.

Vice-President.

In the absence of the President, a Vice-President shall preside at the meetings of the Association; and in the absence of all of them a President pro-tem shall be elected by the meeting.

ARTICLE VII.

The Recording Secretary.

The Recording Secretary shall keep a record of the proceedings of the Association, and the Executive Committee, and shall be custodian of all documents, books and collections ordered to be preserved.

ARTICLE IX.

The Corresponding Secretary.

The Corresponding Secretary shall conduct the correspondence of the Association. He shall keep a list of members, with their residences, and shall notify members of the time and place of all meetings of the Association. He shall receive annual dues and receipt for the same in the name of the Treasurer.

ARTICLE X.

The Treasurer.

The Treasurer shall have the custody of all moneys received. He shall deposit and invest the same in such manner and to such extent as the Board of Directors shall direct, and shall not expend any money except under the direction or approval of the Board of Directors, or the Executive Committee as authorized by said Board. The financial year of the Association shall close on November 30 of each year.

ARTICLE XI.

The Executive Committee.

The Executive Committee shall, subject to the supervision and approval of the Board of Directors, transact all current business of the Association. It shall consist of the President of the Association, the Vice-President for the District of Columbia, the two Secretaries, the Treasurer, and six (6) other Active members. This committee shall choose its own chairman, and three (3) members of it shall constitute a quorum. The Executive Committee by authorization of the Board of Directors may pass upon all bills presented to the Association and approve for payment such as it deems just and reasonable, and may incur on behalf of the Association liabilities not to exceed such sums as may be fixed by the Board of Directors.

ARTICLE XII.

Meetings.

The annual meeting for the election of officers and the transaction of such business as requires to come before the entire Association, shall be held on the second Wednesday in December, at such hour and place as the Executive Committee may determine.

A quorum shall consist of fifteen (15) members of the Association (Patrons, Life members or Active members), as specified in section 5 of Article III.

Special meetings may be called by the Executive Committee.

ARTICLE XII.

Dues.

The annual dues for Active members shall be two dollars (\$2) payable in advance upon the first day of January.

The Board of Directors shall have power to remit the annual dues of a member.

ARTICLE XIV.

Amendments.

These By-Laws may be amended by a three-fourths vote of the members present and entitled to vote at the annual meeting of the Association.

Fifteenth Annual Meeting,

1897.

Pursuant to notice, the fifteenth annual meeting of the American Forestry Association was held on February 5, 1897, in the hall of the Cosmos Club, at Washington, D. C. Articles of incorporation of "The American Forestry Association" having been filed just previous to the meeting, the old organization was thereby supplanted by the new corporation.

The meeting was called to order at 10.15 A. M. In the absence of the President, Mr. Gardiner G. Hubbard, the Vice-President for the District of Columbia, took the chair. The minutes of the last annual meeting were read and approved. Dr. B. E. Fernow then read the following report of the Executive Committee, which was accepted:

REPORT OF EXECUTIVE COMMITTEE.

In all reform movements which, like our forestry movement, involve change of economic thought and methods, there are times, when progress can hardly be noted by definite events and tangible steps of advancement, and yet progress is made without special effort, insensibly, by an almost imperceptible broadening of appreciation of the subject, a result of the momentum of earlier efforts; the front may not advance, but more battalions move into line.

The past year may perhaps be considered in the history of the Association as such a time of bringing up arrears, of broadening interests, of movements into line and reaping results of its influence rather than achieving advances on given lines.

As the most notable of these movements may be mentioned the appointment of a Forestry Committee by the National Academy of Sciences, which was secured through the efforts of your Executive Committee by inducing the then Secretary of the Interior to ask the advice of the National Academy—the legally constituted advisor of the Government in matters scientific—regarding the proper steps to be taken with reference to the public timber lands.

An appropriation of \$25,000 was readily secured from Congress for this committee to enable its members to inspect the condition of these

timberlands as a basis for its recommendations. It is known that such inspection was made and a report is preparing, although we are not informed of the drift of its recommendations. Your committee, in securing the appointment of this body did not expect that its recommendations would be essentially or strikingly different from those made and advocated by your Association, but hopes that the weight of the opinion of the eminent gentlemen composing the Forestry Committee and of the body from which it was selected will do much to arouse more generally public interest and to secure the passage of desired legislation.

During the last session of Congress the McRae Bill H. R. 119, was again passed in the House of Representatives, with amendments, to be sure, which do not meet the approval of your committee. Nevertheless, we would prefer the passage of the bill for the good that is in it, rather than favor the continued lack of a definite legal status and of all protection for the existing forest reservations, hoping for improvement by later legislation.

In the Senate Mr. Allen has reported and placed on the Calendar a bill from the Committee on Forest Reservations (S. 2118) which is in the main the same as the House Bill, although with further undesirable amendments added.

The hope of passing this legislation, which would mark a first step towards an administration of the existing forest reservations, during the present session of Congress, depends on the willingness of Senator Allen to change his bill in form, so that if passed it can be sent to Conference.

Meanwhile the policy of forest reservations has not only been kept in abeyance, but has become discredited and objectionable with the people in the States, where they are situated, since thereby large areas have been absolutely withdrawn from any, even rational, use, and are left without protection.

A strong opposition has arisen, and strenuous attempts have been made to open for entry or reduce especially the Cascade Range Forest Reserve in Oregon, to counteract which your committee passed and directed to Congress and the Executive the following resolutions:

Adopted March 4th, 1896.

"Whereas, We hear, with regret and apprehension, that an effort is now being made to secure the restoration to the public domain for entry and disposal of three-fourths of the lands comprising the CASCADE RANGE FOREST RESERVE in Oregon, which was created only two years ago by proclamation of the President after due and careful consideration, and upon the recommendation of the Secretary of the Interior; and,

Whereas, It is the duty of the Government to maintain such conditions as will benefit the greatest number and future generations in their economic development, in which permanent water conditions and timber supplies are essential; and,

Whereas, The restoration of these mountain forest lands, which are unfit for agriculture by reason of their ruggedness and altitude, would benefit only a small class, lumbermen and sheepherders, whose occupation of such an area results invariably in the destruction of the forest growth and thereby of favorable water conditions;

Resolved, That we deprecate any return to the irrational practice of disposing of these mountain forest lands, and favor a further extension of the policy of reserving from sale the lands of the Government which are chiefly valuable for timber or for maintaining water conditions.

Resolved, That we respectfully ask that the Cascade Range Forest Reserve be not opened in whole or in part, but urge upon Congress the necessity of immediate legislation which will enable the Secretary of the Interior to permit, under proper regulations and restrictions, the rational and discreet use of all the resources contained in such reservations."

While your committee has held, that until proper administration of existing Forest Reservations could be secured, it would be unwise to press an extension of the reservation policy, it now comes to the conclusion, that such extension may be useful in that it might make the necessity of providing proper administration more urgent and hasten Congressional action.

With this conception your committee transmitted to the President a petition, signed by the Governor and many leading citizens of Utah, for the creation of the Fish Lake Reservation in that State, endorsing the same and recommending early action.

The wisdom of a reservation policy, which means that the Government should own and hold in perpetuity forest lands, whose rational treatment is of special importance to the welfare of the community, has also found acceptance and strong advocates in several of the States, notably West Virginia, Minnesota, Wisconsin, New York and Pennsylvania. A resolution of the W. Va. Academy of Sciences asking for co-operation in securing the appointment of a committee by Congress and the several State legislatures interested, for the purpose of inquiring into the question of protecting the forest-cover of the middle Alleghenies and establishing an interstate forest reservation in the region, was favorably considered by your committee, but it seemed, that as long as the Federal Government hesitates to take care of the timberlands which it owns, it could hardly be expected to join in a movement in which such lands must first be acquired by purchase.

Meanwhile a bill, in part suggested by your committee, has been introduced, reported and advanced to second reading, in the Senate of West Virginia, to create all lands forfeited to the State for non-payment of taxes in the mountainous counties into a Water and Forest Reserve, for the benefit of the State School Fund, and to establish a Commissioner of Forestry, with forest inspectors to aid him in the care and management of the reserve.

The Forestry Association of Minnesota has made considerable progress in shaping public opinion in favor of its proposition, that the State form a forest reserve, and has formulated the necessary legislation for that purpose.

In Wisconsin a similar proposition by the State Forestry Association has not yet advanced to such definite form.

In New York a determined effort to fill out the area of the projected Adirondack Forest Reserve by purchase is on foot, a special legislative committee having submitted its recommendation for such purchase in connection with the proposed enlargement of the State canals.

The elaborate report of the State Forest Commissioner of Pennsylvania foreshadows early action on the part of that State in acquiring the recommended Forest Reserve, and it is evident from the frequency and generality of favorable newspaper comments, that in that State a well sustained, healthy feeling regarding forestry matters has been created by the labors of the energetic Commissioner.

The report of the Chief Fire Warden of the State of Minnesota brings gratifying news regarding the workings of the newly-tried organization to suppress forest fires.

It should also be noted with gratification that the Governors of several States, notably those of New York, Pennsylvania and Minnesota, refer at considerable length to the necessity of more vigorous measures on the part of their several commonwealths in the direction of forest protection.

Two other State Forestry Associations have been added to the list: Those of Oregon and Washington, and it is gratifying to learn that the first meeting of the latter Association was held in connection with a lumbermen's convention, which would argue that its work may be laid out on practical lines.

As this report is being written Michigan is preparing to revive her earlier interest in forestry reform. The Ottawa County Forestry and Tree Culture Association is proposing to make its first annual meeting at Grand Rapids on February 3, the occasion for an effort to resuscitate the Forest Commission of the State, which was abandoned for lack of funds.

From Montana we have signs of the energetic propaganda made by our Vice-President, Lieut. Ahern, who hopes to secure effective forest fire legislation and to induce the Agricultural College to take care of its large forest property in a rational manner. In all these movements the indirect, if not a direct influence of co-operation of the Association is felt.

For the conditions of the movement in other States we refer to the second part of our Volume XI. of Proceedings, just issued, which contains brief reports from the Vice-Presidents of each State.

In educational directions, too, some notable advance has been made, although the measures for the establishment of a post graduate forestry school in connection with the Department of Agriculture were not forwarded beyond a hearing before the Committee on Agriculture and Forestry in the House of Representatives and a report on the bill.

From the University of Washington at Seattle we have news of a well planned course of lectures on general forestry topics being instituted; at the Kansas Agricultural College a more specific course on the technical questions of forest planting is successfully carried on; and the State University of Wisconsin provided for a course in the School of Economics, specially designed for students of political economy, which was delivered by your Chairman with an attendance ranging from 80 to 150 students and professors. Such courses, designed to give a true conception of the value, significance and nature of our forest resources and of forestry as a business to the advanced student in economics, should, it would seem, most quickly be reflected in the legislation on the subject.

It may be appropriate in this connection to refer also as an exhibition of the spread of education on these matters to the resolutions passed by the General Federation of Women's Clubs at Louisville, on May 29, 1896, where several hundred representative women from all parts of the country, standing for many thousands of their associates, expressed in well chosen words their approbation of the efforts of this Association.

The political atmosphere of the last year was such, that it seemed wise not to attempt the holding of a summer meeting.

The question of publishing a separate periodical journal by the Association was, after much deliberation, deferred for the present, and satisfactory arrangements for the continuance of "Forest Leaves" as the organ of the Association were made with a representation of the Association on the staff of editors.

In this connection we are pleased to note that sufficient interest is awakened to warrant the enlargement of the scope and field of the New Jersey Forestry Association's organ, "The Forester," which has begun its appearance as a regular monthly.

Volume XI. of the proceedings of the Association have been printed in three parts. With this volume all reports of meetings and manuscript matter in arrears have been disposed of.

The membership, as the Secretary's report will show, has in spite of a number of resignations materially increased during the year, while the Treasurer's report will show a satisfactory condition of the funds of the Association.

The incorporation of the Association has been effected and the members present at this meeting will have the privilege of electing for the first time the Directors provided by the law and will have to adopt new by-laws, which have been prepared by the committee to satisfy the requirements of the law. The incorporation is, of course, principally made to enable the Association to accept donations of funds in furtherance of its objects.

That with such funds at its disposal and a paid Secretary, who would devote all his time to the propaganda, the forestry movement could be made to advance much more rapidly than now when all the work done must be by voluntary unpaid exertions of busy men, stands to reason. Perhaps even practical demonstrations in the proper management of

forest tracts may eventually become a part of the Association's work, when generous patrons are ready to endow it.

At the last annual meeting the question of affiliation of local forestry associations with this Association was referred to the Executive Committee for the formulation of a practical plan. Such a plan has now been formulated, subject to approval by the present meeting as follows:

Any local, State, or other forestry association may upon proper official application and approval of your Executive Committee become affiliated. Such affiliation shall entitle such society to the following representation in this Association: The President and Secretary of the affiliated society shall become enrolled as active members of this Association without payment of dues for the time of their holding office. In addition, for every ten members of the affiliated society, who shall pay \$1.00 into the Treasury of this Association and receive therefor the proceedings and journal of this Association (Forest Leaves, at present,) one of their number elected or designated by the affiliated society shall become an active member of this Association without charge of dues until his successor is designated.

The Treasurer's report, as shown in condensed form below, was then read, accepted, and referred to an auditing committee consisting of Messrs. William F. Fox and George B. Sudworth. The balance shown for the account current, \$363.40, is that on hand January 1, 1896. In the Treasurer's report, as printed on page 39 of Vol. XI. of the Proceedings, the balance is stated at \$114.30, this being the amount up to January 24, subsequent to the payment of several bills included in the year 1895, notably for Forest Leaves, \$223.04; clerical services, \$60.74. From these are to be deducted interest on general secretary fund, \$9.68, and annual contributions, \$25, making the balances agree.

H. M. Fisher, Treasurer, in account with the American Forestry Association.

"ACCOUNT CURRENT."

DR.

Jan. 1.	Balance account.....	\$ 363.40
	Received from contributions.....	1,119.00
	Interest on \$2,000, 5 per cent. bonds.....	100.00
	Interest on \$500 Security Mortgage & Trust.....	
	Debenture	12.50
	Interest allowed on deposits.....	17.89
		<hr/>
		\$1,612.79

CR.

"Forest Leaves" for 1895.....	\$ 223.04
"Forest Leaves" for 1896.....	247.68
Clerical assistance.....	378.99
Postage.....	141.66
Stationery	45.74
Rent of Hall, etc.....	62.86
Printing Proceedings.....	183.13
Sundry printing.....	76.51
Balance.....	253.18

\$1,612.79

"LIFE MEMBERSHIP FUND."

DR.

1896.	
Jan. 1.	Balance of account.....\$ 332.98
	Received for Life Memberships..... 250.00
	Interest allowed on deposits..... 9.22

\$592.20

CR.

1896.	
June 30.	Paid Trust Co. of North America for \$500 Security Mortgage & Trust Co. (of Dallas, Tex.) 5 per cent. Debenture. Interest payable 1st of January and 1st of July.....\$ 500.00
1897.	
Feb. 2.	Balance..... 92.20

\$592.20

(The principal of this fund consists of investment in \$2,000 United States 5 per cent. bonds, and \$500 Security Mortgage & Trust Co. 5 per cent. debenture.)

Mr. F. H. Newell then read the following report, as Corresponding Secretary, for the year 1896:

The duties of this office have been mainly that of replying to letters, collecting dues and endeavoring to obtain new members. Incidental to this there is necessarily a considerable body of correspondence and clerical work. Exact account has not been kept of the number of letters received and sent, but from the postage used it appears that about 1,500 letters, notes and circulars have been sent out, exclusive of printed notices. There have been collected and turned over to the Treasurer,

the amount of \$1,309. The amount collected the preceding year was \$540. A considerable part of this increase was due to the attempt made to collect old dues.

The membership has been increased by letters and circulars sent to addresses *furnished by members. Taking the list as published in Vol. XI., Part I, as showing the condition of the membership at the last annual meeting, it will be seen that there were at that time 68 life members, and 566 annual members, making a total of 634. This number has been increased by 4 life members and 118 annual, making a total increase of 122. From this should be deducted the names of 7 deceased members, 25 resigned, and 19 dropped for non-payment of dues, leaving net membership of 72 life members, 633 annual members, or in all 705, as shown by the following table:

<i>Changes in Membership.</i>			
	Life.	Annual.	Total.
Condition, March, 1896.....	68	566	634
Deduct 1896 (died 7, resigned 25, dropped 19).. <hr/>	51	51	51
	68	515	583
Increase, 1896..... <hr/>	4	118	122
Total.....	72	633	705

The large number who have resigned or whose names have been dropped is due to the fact that a persistent effort has been made to collect past dues in order that the list of members might not be encumbered

*The following is the form of circular letter generally used:

DEAR SIR: Your name has been offered by a member of this Association with the suggestion that you would probably desire membership if you were informed as to the objects of this organization. I therefore enclose a copy of the constitution, and, should you so desire, will send other literature upon the subject.

The American Forestry Association was organized in 1882, and now has members in nearly all of the larger political divisions of North America. It has published from year to year reports and discussions concerning the condition of the forests of this continent, and has at all times been active in the advancement of educational and legislative measures tending to promote a more rational treatment of forest resources. The opportunities for promoting the objects of the Association are now better than at any previous time, and a greater demand is being made for facts and conclusions. In order to be in touch as well as to aid in educating and directing public opinion, it is necessary to increase the membership so that the Association shall include leading men and women in every community. At present, while forestry matters are under discussion by committees of National and State Legis-

with names of those who were not willing to contribute to the annual expenditures. There are now outstanding annual dues to the amount of about \$400, the greater portion of these being for the year 1896. They will probably be paid for the most part when the bills for 1897 are sent out.

Were it possible to devote any considerable amount of time and thought to this work it appears probable that the membership, and as a consequence the efficiency of the organization, could be increased many fold. The numerous official and personal duties prevent my giving more than occasional thought to the work of this association, and I am compelled to leave many details to others. I appreciate keenly the unavoidable shortcomings and hope that the time will not be far distant when this work can be taken up by some competent person who can devote all of his time to the objects of the association.

The following list was then read of past members of whose decease the Corresponding Secretary had been notified:

Members, Deceased.

Willits, Edwin, Washington, D. C.
 Metcalf, V. M., Hopkinsville, Ky.
 Codman, Philip, Brookline, Mass.
 Peabody, O. W., Boston, Mass.
 Reed, D. W., Blue Springs, Colo.
 Bowden, Hugh, Glens Falls, N. Y.
 Weltz, Leo, Wilmington, Ohio.
 Cutler, Aug. W., Norristown, N. J.
 Loring, Caleb William, Pride's Crossing, Mass.
 Davis, Daniel F., Bangor, Me.
 Hubbard, Bela, Michigan.

latures and by the public, much good can be accomplished by organized effort.

This Association includes and desires as members all interested—owners of timber and wood-land, lumbermen and foresters, as well as engineers, professional and business men, who have to do with wood and its manifold uses. Interest is sustained by the exchange of ideas and by discussions at the annual and special meetings. The members receive the annual reports and the bi-monthly publication, "Forest Leaves," the official organ of the Association; also, through the efforts of officers and friends there are sent to them occasional reports and papers giving results of careful investigations of subjects, as of timber physics, bearing more or less directly upon forests and their utilization. The annual dues are \$2, and life membership \$50.

I trust that you will give this matter due consideration, and, appreciating the objects and benefits of the Association, will signify your desire to become a member.

Very respectfully yours,

F. H. NEWELL,
Corresponding Secretary.

The Chair then appointed the following committees: On Nominations, French, Bowers, Fox, Gannett and Binney; on By-Laws, Higley, Whittlesey and Moses; and on Resolutions, Appleton, Keffer, Barnard and Gifford.

An invitation from the Governor of Tennessee, the Nashville Chamber of Commerce, the Mayor of Nashville, the Director-General of the Tennessee Centennial, and others, to hold a meeting of this Association at Nashville, at the time of the celebration of the Centennial of the admission of Tennessee to the Union, was read by the Chair, and, on motion, was referred to the Committee on Resolutions.

The report of the Executive Committee was then discussed informally by Messrs. French, Birkenbine, Fox, Moses, Gifford, Bowers, and others. During the discussion, Mr. Hubbard was obliged to leave on account of a prior engagement, and Gen. Francis H. Appleton, the Vice-President from Massachusetts, took the chair. Judge Warren Higley presented the report of the Committee on By-Laws, which was accepted. A recess was then taken till 2.30 P. M.

AFTERNOON SESSION.

General Appleton called the meeting to order at 2.30. The by-laws proposed by the Committee on By-Laws were discussed at length, and, after amendment, were adopted. On motion, the subject of a design for the corporate seal was referred to the Board of Directors. Mr. French then presented the report of the Committee on Nominations, and, on motion of Judge Higley, the Secretary cast the ballot for the nominees (whose names are given on page 3.)

Mr. Gifford, for the Committee on Resolutions, reported the following, which, after discussion, were adopted:

Resolved, Reiterating our support of the McRae Bill, H. R. 119, to protect and administer the public forest reservations, which passed the House of Representatives at the first session of the present Congress, we deplore the seeming impossibility of its being taken up in the Senate during the current session, and emphasize our regret that slight personal differences of opinion should operate to stay the passage of legislation so clearly designed to inaugurate a national system of forest preservation and management.

Resolved, As a fundamental proposition of rational forestry, we commend the well-organized effort of the State of Minnesota to suppress forest fires, being aware that no advance in forest management can be made without such protection.

Resolved, We urgently recommend that the Federal and State Legislatures take measures to encourage the study of Forestry in all Agricultural Colleges, Technical and Normal schools, throughout the United States, and we hope that the report of the Forestry Committee of the National Academy of Sciences will not only recommend legislation similar to that advocated by this Association, but will embody recommendations looking towards the establishment of means of education as herein suggested.

Resolved, That we recommend to the Executive Committee that it accept the cordial invitation extended by the Director-General of the Tennessee Centennial, and others, to hold a meeting at Nashville, date and necessary arrangements to be fixed by the Executive Committee.

Resolved, The American Forestry Association expresses its hearty approval of the efforts heretofore put forth and which may be hereafter made on the part of the several States to establish State forest reservations. The states of New York, Pennsylvania, New Hampshire, Minnesota and West Virginia, have under consideration in their several legislatures bills for the establishment and enlargement of such reserves. The friends of forestry everywhere should view these efforts with sympathetic interest and further such legislation in every possible way.

Mr. Sudworth, for the Auditing Committee, reported that the accounts of the Treasurer had been examined and found correct.

General Appleton, the newly-elected President, in a few remarks accepting the office, suggested that local committees be formed in different States and cities to work up the membership of the Association.

On motion of Mr. Newell, the thanks of the Association was tendered the Cosmos Club for the use of its hall. On motion of Judge Higley, the thanks of the meeting were extended to the Executive Committee, and especially to its efficient chairman, for his excellent work and generous hospitality.

In reply to an inquiry by Mr. French, Mr. Newell detailed the unsuccessful attempts which had been made to carry out a resolution passed at the last annual meeting in regard to increasing local interest in Forestry. The meeting then adjourned.

After the close of the afternoon session, the Board of Directors held a meeting, at which were present Messrs. Appleton, Bowers, Fernow and Whittlesey. General Appleton was elected President of the Board, and Mr. Whittlesey, Secretary.

EVENING SESSION.

A joint meeting was held with the National Geographic Society at the First Congregational Church, at which Dr. B. E. Fernow delivered a most entertaining and instructive lecture, illustrated by fine stereopticon views, upon the Forests of Arizona, and the Grand Canyon of the Colorado.

Forestry Legislation.

In this connection it will be interesting to show that the agitation for rational treatment of the public timber domain is by no means of recent date, but may be said to celebrate this very year its silver jubilee. A quarter century ago, exactly, the first true forestry bill was introduced by Mr. Haldeman in the 42d Congress, and was lost. It provided that in the disposal of the public domain the condition be inserted into the patents that 10 per cent. of the land shall be kept in timber, or, if not timbered, shall be planted to timber.

The subjoined table exhibits the long struggle for some kind of legislation; the failure of the numerous bills introduced, and the inactivity of Committees and Legislatures. It was originally printed in Bulletin 2 of the Division of Forestry, Department of Agriculture, in 1887, and has been here brought up to date.

It will be seen that hardly any kind of legislation which could be suggested has been overlooked, from the creation of forest commissions to investigate the subject to that providing for fully organized forest administrations and the establishment of forestry schools.

The earliest action of the general government having regard to the preservation of timber was in 1799, when Congress appropriated \$200,000 for "the purchase of growing or other timber, or of lands on which timber is growing, suitable for the Navy, and for its preservation for future use." The special object of this legislation was to secure a supply of Live-Oak timber, which was considered peculiarly valuable for ship-building, and was in great demand for that purpose, both at home and abroad, while its growth was confined to a limited portion of our territory in the vicinity of the Gulf. Two small islands on the coast of Georgia, containing

together about 2,000 acres, were purchased under the Act of 1799. Another Act (Revised Statutes, section 2458), having the same object in view, was passed in 1817, by which the Secretary of the Navy was directed to cause lands producing Live Oak or Red Cedar to be explored, and to have selections made of tracts necessary to furnish for the Navy a sufficient supply of such timbers. Under this Act 19,000 acres in Louisiana, which had recently become ours by purchase from France, were reserved.

Additional enactments were made in 1820 and 1827, by which the selection of lands to be reserved was intrusted to the Surveyor of Public Lands in place of agents appointed by the Secretary of the Navy, and the President was authorized to withhold such lands from sale.

In 1822, an Act was passed (Revised Statutes, section 2460), authorizing the President to employ the land and naval forces so far as necessary effectually to prevent the felling or other destruction of timber in Florida, and to take such other measures as might be deemed advisable for the preservation of timber there. (Florida had recently been ceded to the United States by Spain, and was known to abound in Live-Oak timber.)

In 1831, an Act was passed (Revised Statutes, sections 2461, 2462, and 2463) of wider scope than that of 1822. This made it a felony, with penalty of fine and imprisonment, to cut or remove timber from any of the public lands, whether reserved or not, except for the use of the Navy, and subjected any vessel transporting such timber without proper authority and for any other purpose than for the use of the Navy, to confiscation and the master of the vessel to a fine.

This Act is the one under which, up to the present time, all the protection they have had has been secured to the public forests, the Supreme Court having construed the Act (9 How., 351) as authorizing the protection of all timber on the public lands, and punishment for trespass upon the same. Under the Act of 1831, the Treasury Department undertook a partial oversight and protection of timber on the public lands through its ordinary agents. In 1855 this oversight was transferred to agents of the Land Department, registers and receivers being instructed to act also as timber agents, but without any additional

compensation. Where trespass was willfully committed, payment of stumpage was demanded or the timber was seized and sold and the proceeds paid into the Treasury. Where the trespass was committed ignorantly, actual entry of the land only was required, with payment of the usual entry charges.

The first appropriation for the payment of agents specially employed for the protection of timber on the public lands was made in 1872, when \$5,000 were appropriated. A like sum was appropriated annually thereafter for five years. In 1878, to meet expenses for suppressing depredations upon timber on the public lands, \$25,000 were appropriated, and subsequently these appropriations were increased until, in 1893, they reached the limit of \$120,000, then to be reduced to \$40,000, \$60,000, and \$90,000, for 1894, 1895, and 1896 respectively.

Year.	Congress.	House in which originated.	Object of Bill.	Action taken.
1871	41st, 3d sess.	H. R. 2930, Sargent.	For the sale of timber lands in California and Oregon.	Referred to Committee on Public Lands.
1871	41st, 3d sess.	H. R. 3005, Sargent.	To authorize the sale of timber lands in California, Oregon, and Washington Territory, not exceeding 640 acres to one person or association, without residence, at \$2.50 per acre.	Passed in House. In Senate referred to Committee on Public Lands.
1871	42d, 1st sess.	H. R. 274, Garfield.	Same as the preceding.....	Referred to Committee on Public Lands.
1872	42d, 2d sess.	H. R. 2197, Haldeman.	To encourage the planting of trees and the preservation of woods on the public domain. (The first real and comprehensive forestry bill.)	Referred to Committee on Agriculture. Reported favorably. Failed of passage—81 yeas, 87 nays.
1872	42d, 2d sess.	Resolution that the Committee on Agriculture inquire whether a certain percentage of each quarter section of public lands sold must be planted with trees or a certain percentage of existing forests preserved for the purpose of preventing or remedying drouth.	No action.
1873	43d, 1st sess.	H. R. 410, Page.	Same as Garfield bill (274) above.	Referred to Committee on Public Lands. June 3, reported back with amendments and recommittees. December, 1874, H. R. bill 4194 reported by committee as substitute. Passed February 22, 1875. In Senate February 22, referred to Committee on Public Lands.

Year.	Congress.	House in which originated.	Object of Bill.	Action taken.
1874	43d, 1st sess.	Senate 471, Boutwell.	For the survey and disposal of the timber lands of the United States. Miners may buy stumpage, not more than 160 acres, till that is cut, at \$2.50 per acre. Homesteaders may buy 40 acres of timber land near agricultural land at same price.	Referred to Committee on Public Lands. Reported with amendments.
1874	43d, 1st sess.	H. R. 2497. Herndon.	For the appointment of a commission for inquiry into the destruction of forests and into the measures necessary for the preservation of timber.	Referred to Committee on Public Lands. Reported back with H. R. 2540 as a substitute.
1874	43d, 1st sess.	H. R. 2540, Dunnell.	For the appointment of a commissioner to inquire into the destruction of forests and into the measures necessary for the preservation of timber.	Reported by Committee on Public Lands as a substitute for preceding bill, H. R. 2497.
1875	43d, 2d sess.	H. R. 4430, Averill.	To regulate the survey and sale of the timber lands of the United States. Commissioner of the Land Office to survey and appraise lands more valuable for their timber than for agricultural use. Such lands not to be entered under homestead or pre-emption laws, but appraised and offered at public sale, and if not sold then to be open to private entry at a price not less than the appraisal.	Referred to Committee on Public Lands.
1875	44th, 1st ses.	H. R. 323, Dunnell.	To regulate the survey and sale of the timber lands of the United States. Same bill as the preceding.	Referred to Committee on Public Lands.
1875	44th, 1st ses.	Senate 2, Clayton.	To repeal section 2303 of the Revised Statutes, thereby opening timber lands in Southern States to private entry in unlimited quantities and at the reduced price of \$1.25 per acre.	Referred to Committee on Public Lands. Reported back and passed. In H. R. referred to Committee on Public Lands. Passed H. R. and became a law July 4, 1876, through inaction of the President.
1875	44th, 1st ses.	Senate 6, Kelley.	For sale of timber lands in California, Oregon, and the Territories. Same as previous bills with similar title.	Referred to Committee on Public Lands. Passed Senate February, 1876. In H. R., February, 1876, referred to Committee on Public Lands. March, 1877, House refused to suspend rules and pass the bill.
1876	44th, 1st ses.	H. R. 660, Maginnis.	For the sale of the timber lands in the Territories. Lands valuable for timber but not for cultivation to be sold at \$2.50 per acre, not more than 40 acres to one person.	Referred to Committee on Public Lands.

Year.	Congress.	House in which originated.	Object of Bill.	Action taken.
1876	44th, 1st ses.	H. R. 1191, Saylor.	To regulate the survey and sale of the timber lands or the United States. Lands valuable chiefly for timber not to be subject to entry under preemption or homestead laws, but to be appraised and sold at not less than the appraised value.	Referred to Committee on Public Lands. Reported with amendments and re-committed.
1876	44th, 1st ses.	H. R. 1310, Dunnell.	For the appointment of a commission, etc. Same as preceding bill (H. R. 2540.)	Referred to Committee on Public Lands. No opportunity was afforded for regular action on the bill, but, on motion of Mr. Dunnell, the substance of it was added as an amendment to the general appropriation bill, and became a law August, 1877.*
1876	44th, 1st ses.	H. R. 2075, Fort.	For the preservation of the forests adjacent to the sources of navigable rivers and other streams. Such timber lands to be withdrawn from sale and a commission to determine what should be reserved so as to prevent scanty supply of water.	Referred to Committee on Public Lands.
1877	45th, 1st ses.	H. R. 797, Maginnis.	For the sale of timber lands in the Territories. Same as bill (660) of Mr. Maginnis in Forty-fourth Congress.	Referred to Committee on Public Lands.
1877	45th, 1st ses.	H. R. 1154, Pacheco.	To regulate the survey and sale of timber lands of the United States. Same as bills in the Forty-third and Forty-fourth Congresses.	Referred to Committee on Public Lands.
1877	45th, 1st ses.	H. R. 1525, Herbert.	To put into market certain timber lands of the United States. Declaring subject to entry, in any quantity, all public timber lands in Alabama, Louisiana, and Minnesota which have been subject to entry in limited quantities for twenty years and after entry of such lands to be no prosecution for trespass or timber cutting.	Referred to Committee on Public Lands.
1878	45th, 2d sess.	H. R. 2658, Maginnis.	To provide for the entry of unsurveyed timber lands. Allowing the owner of a mine to take 160 acres of timber land for every 20 acres of mineral land owned by him, and the owner of agricultural land 40 acres for every quarter section, and for every \$20,000 expended on a mill or furnace 640 acres may be taken at \$2.50 per acre.	Referred to Committee on Public Lands.

*By this enactment the Commissioner of Agriculture was directed to appoint a competent person to make the contemplated inquiries and investigations. The Commissioner appointed for this work Mr. F. B. Hough, and the prosecution of the work led to the establishment of the Forestry Division in the Department of Agriculture. The result of Mr. Hough's inquiries has been published in three volumes. The work begun by him has been continued by his successors in charge of the Forestry Division, so far as the small appropriation made by Congress for the purpose would allow, and additional reports have been published.

Year.	Congress.	House in which originated.	Object of Bill.	Action taken.
1878	45th, 2d sess.	H. R. 3981, Patterson.	Withdrawing lands chiefly valuable for timber from entry under pre-emption or homestead laws. Such lands to be surveyed and divided into "timber lands" and mineral timber lands." On the latter the timber only to be sold. Timber lands to be appraised and sold by commissioners. Such lands as are needed for irrigation purposes to be withheld from sale.	Reported by Committee on Public Lands as a substitute for several bills. Re-committed.
1878	45th, 2d sess.	\$25,000 appropriated to suppress depredations on public timber.	
1878	45th, 2d sess.	Senate 926, Sargent.	Allowing sale of timber lands unfit for cultivation in California, Oregon, Nevada, and Washington Territory at \$2.50 per acre. No one person or association to enter more than 160 acres.	Referred to Committee on Public Lands. Passed Senate. Reported to and passed H. R. Approved by President, June 3.
1878	45th, 2d sess.	H. R. 3800, Wren.	Bill similar to next below....	Referred to Committee on Public Lands.
1878	45th, 2d sess.	Senate 20, Chaffee.	Allowing residents of Colorado, Nevada, and other Territories, and all mineral districts, to fell and remove, for building and other domestic purposes, trees on mineral lands.	Referred to Committee on Public Lands. Amended and passed by Senate. Passed H. R. and signed by President June 3.
1879	45th, 3d sess.	H. R. 6087, Dunnell.	To regulate the survey and sale of timber lands. Same as bill presented December, 1875 (H. R. 323), providing that timber lands more valuable for lumber than for agricultural purposes be reserved from entry under homestead or pre-emption laws, appraised, and sold to highest bidder, but not for less than appraisement.	Referred to Committee on Public Lands.
1879	46th, 1st sess.	H. R. 1164, Dunnell.	To regulate the survey and sale of timber-lands of the United States. Same as last bill above.	Referred to Committee on Public Lands.
1880	46th, 2d sess.	H. R. 6321, Carlisle.	To prevent depredations upon timber in the Indian Territory.	Referred to Committee on Indian Affairs
1880	46th, 2d sess.	H. R. 6340, Downey,	Authorizing citizens of Colorado, Nevada, and the Territories, to fell and remove timber on the public domain, for mining and domestic purposes. Extending the act of June, 1878.	Referred to Committee on Public Lands.
1880	46th, 2d sess.	Senate 1812, Coke.	To prevent depredations upon timber on Indian reservations.	Reported from the Committee on Indian Affairs.
1880	46th, 2d sess.	H. R. 6371, Hooker.	To prevent depredations upon timber on the Indian reservations. Same as last bill above.	Referred to Committee on Indian Affairs

Year.	Congress.	House in which originated.	Object of Bill.	Action taken.
1880	46th, 2d sess.	H. R. 1846, Herbert.	Act condoning trespass on public lands prior to March 1879. Persons against whom suits were pending prior to that date to enter lands trespassed upon and pay accrued costs, thereupon suits to be discontinued. At same time price to be paid for lands to be reduced from \$2.50 to \$1.25.	Approved by the President June 15, 1880.
1882	47th, 1st ses.	Senate 760, Teller.	For the classification of the public lands in Colorado and the sale of timber thereon. The Secretary of the Interior to regulate the sale, and may reserve timber on head-waters of streams and on mountains.	Referred to Committee on Public Lands.
1882	47th, 1st ses.	Senate 1641, Teller.	To amend act of 1878, so as to allow any one in Western States and Territories to remove timber from mineral lands for any purpose, under rules and regulations of the Secretary of the Interior and payment of \$2.50 per acre for the timber. No timber to be cut by mill-owners or lumber manufacturers.	Referred to Committee on Public Lands.
1882	47th, 1st ses.	Senate 1826, Sherman.	For the preservation of woods and forests adjacent to sources of navigable rivers. Same as bill introduced in H. R. 1st session, Forty-fourth Congress.	Referred to Committee on Agriculture.
1882	47th, 1st ses.	H. R. 6315, Butterworth	For the preservation of woods, etc. Same as Senate bill next above.	Referred to Committee on Agriculture.
1882	47th, 2d sess.	H. R. 6997, Strait.	To provide for the classification and disposition of pine timber-lands. Such lands, chiefly valuable for their timber, not to be subject to pre-emption or homestead entry, but to be appraised by the Secretary of the Interior, and sold from time to time at public sale, for not less than two-thirds the appraisement. Mineral lands exempt from the act.	Referred to Committee on Public Lands.
1883	47th, 2d sess.	H. R. 7509, Dwight.	To regulate the sale of the timber lands of the United States. Similar to last bill above, but lands remaining unsold to be subject to private entry at the appraised value.	Referred to Committee on Public Lands.
1883	47th, 2d sess.	Senate 2495, Tabor.	For the protection and preservation of the forests of the United States. One hundred thousand dollars to be appropriated to Colorado for the establishment of an experiment station under the direction of the Department of Agriculture.	Referred to Committee on Appropriations.

Year.	Congress.	House in which originated.	Object of Bill.	Action taken.
1883	47th, 2d sess.	H. R. 4757,	Act to exclude the public lands in Alabama from the operation of laws relating to mineral lands. (In reality an act to sell all mineral lands in Alabama as agricultural lands, at private sale, in unlimited quantities, and at the reduced rate of \$1.25 per acre, to citizens or aliens).	Approved by the President March 3, 1883.
1883	48th, 1st ses.	H. R. 832, Strait.	For the classification and disposition of pine timberlands. Same as above bill presented in Forty-seventh Congress.	Referred to Committee on Public Lands.
1883	48th, 1st ses.	Senate 1253, Sherman.	For the preservation of woods and forests adjacent to sources of navigable rivers, etc. Same as bill in Forty-seventh Congress.	Referred to Committee on Agriculture.
1883	48th, 1st ses.	H. R. 4811, Hatch.	For the preservation of woods, etc. Same as last bill above.	Referred to Committee on Agriculture.
1883	48th, 1st ses.	H. R. 5206, Deuster.	For the preservation of woods, etc. Same as last bill above.	Referred to Committee on Agriculture.
1884	48th, 1st ses.	Senate 1544, Dawes.	To prevent cutting of timber on military or Indian reservations.	Referred to Committee on Indian Affairs. Passed in Senate, April 23. In H. R. referred to Committee on Indian Affairs.
1884	48th, 1st ses.	Senate 1183, Cameron.	For the protection, preservation, and extension of the forests of the United States. To establish an experiment station in connection with the Department of Agriculture, west of the Mississippi River. To propagate and distribute forest trees, investigate qualities, time of growing, profit, etc. One hundred thousand dollars appropriated.	Referred to Committee on Agriculture and Forestry.
1884	48th, 1st ses.	Senate 1824, Edmunds.	Act to establish a forest reservation on the headwaters of the Missouri and Columbia Rivers.	Passed Senate June, 1884. In House printed.
1884	48th, 2d sess.	Senate 2451, Miller.	For the protection of forests on the public domain. Withdraws all timberland from sale under existing laws. Forest Commission to be appointed to examine and classify forest lands and determine what should be permanently reserved. Timber on reserved lands to be sold under direction of the Commissioner of the Land Office.	Referred to Committee on Agriculture. Reported favorably.
1885	49th, 1st ses.	Senate 581, Edmunds.	To establish a forest reservation in Montana. Same as bill S. 1824, in Forty-eighth Congress.	Referred to Committee on Agriculture. Reported favorably. Passed Senate. In H. R. on calendar.

Year.	Congress.	House in which originated.	Object of Bill.	Action taken.
1885	49th, 1st ses.	H. R. 379, Payson.	To repeal act of 1878, for the sale of timber-lands in California, Oregon, Nevada, and Washington Territory.	Referred to Committee on Public Lands.
1885	49th, 1st ses.	H. R. 2946, Hatch.	For the preservation of woods and forests adjacent to sources of navigable rivers, etc. Same as bill offered in Forty-eighth Congress.	Referred to Committee on Agriculture.
1885	49th, 1st ses.	Senate 551, Sherman.	For the preservation of woods and forests adjacent to sources of navigable rivers, etc. Same as bill next above.	Referred to Committee on Agriculture.
1886	49th, 1st ses.	H. R. 5556, Oates.	To define and punish the offense of setting fire to woods or forests belonging to the United States.	Referred to Committee on Judiciary. Reported at second session, with amendments, and placed on the Calendar.
1887	49th, 2d sess.	H. R. 10430, Markham.	For the protection of forests in California. To withdraw from sale Government forest lands in California not suited to agriculture. Such lands not to be alienated from the Government, but to be placed temporarily under the management of the forest commissioners of California. Fifty thousand dollars appropriated to carry out the act.	Referred to Committee on Public Lands. Reported favorably.
1888	50th, 1st ses.	Senate 16, Dolph.	To set apart from the public domain in the State of Oregon, as a public park for the benefit of the people of the United States, townships 27, 28, 29, 30 and 31, in ranges 5 and 6, east of the Willamette meridian, in the State of Oregon.	Reported back adversely and indefinitely postponed.
1888	50th, 1st ses.	Senate 196, Gibson.	To cancel certain reservations of lands on account of live-oak in the southwestern land district of the State of Louisiana.	Referred to Committee on Public Lands. Reported back. Passed Senate. Referred to House Committee on Public Lands. Reported back. Amended and passed House. Senate concurs in House amendment. Examined and signed. Approved by President.
1888	50th, 1st ses.	Senate 540, Edmunds.	To establish a forest reservation on the headwaters of the Missouri River and the headwaters of Clark's Fork of the Columbia River.	Referred to Committee on Agriculture and Forestry.
1888	50th, 1st ses.	Senate 596, Sherman.	For the preservation of the woods and forests of the national domain adjacent to the sources of the navigable rivers and their affluents in the United States.	Referred to Committee on Agriculture and Forestry.

Year.	Congress.	House in which originated.	Object of Bill.	Action taken.
1888	50th, 1st ses.	Senate 957, Bowen.	To establish a public park at Pagosa Springs in the State of Colorado.	Referred to Committee on Public Lands. Reported back with amendments. Amended and passed Senate. Referred to House Committee on Public Lands.
1888	50th, 1st ses.	Senate 1476, Hale.	For the protection and administration of the forests the public domain.	Referred to Committee on Agriculture and Forestry.
1888	50th, 1st ses.	Senate 1779, Hale.	For the protection and administration of the forests of the public domain.	Debated and referred to the Committee on Agriculture and Forestry.
1888	50th, 1st ses.	Senate 1817, Dolph.	To grant the State of Oregon townships 27, 28, 29, 30 and 31, south, in ranges 5 and 6, east, of the Willamette meridian in the State of Oregon, for a public park.	Referred to Committee on Public Lands. Reported back with amendment. Amended and passed Senate. Referred to House Committee on Public Lands.
1888	50th, 1st ses.	Senate 2427, Bowen.	To establish a public park to be called and known as the Royal Arch Park.	Referred to Committee on Public Lands. Reported back with amendments. Amended and passed Senate. Referred to House Committee on Public Lands.
1888	50th, 1st ses.	Senate 2510, Teller.	To amend act authorizing citizens of Colorado, Nevada, and the Territories to fell and remove timber on the public domain for mining and domestic purposes.	Referred to Committee on Public Lands.
1888	50th, 1st ses.	Senate 2877, Teller.	Authorizing citizens of Colorado, Nevada, and the Territories to fell and remove timber on the public domain for mining and domestic purposes.	Referred to Committee on Public Lands.
1888	50th, 1st ses.	H. R. 1225, Thompson.	For the protection of forest lands belonging to the United States and Colifornia.	Referred to Committee on Public Lands.
1888	50th, 1st ses.	H. R. 1256, Symes.	To establish a public park at Pagosa Springs, Colo.	Referred to Committee on Public Lands.
1888	50th, 1st ses.	H. R. 1300, Payson.	To repeal the timber-land act of June 3, 1878.	Referred to Committee on Public Lands. Laid on table.
1888	50th, 1st ses.	H. R. 1353, Weaver.	To further amend the public-land laws, and for the preservation of natural forests on the public domain, the protection of water supply, and for other purposes.	Referred to Committee on Public Lands.
1888	50th, 1st ses.	H. R. 1982, Joseph.	To set apart a certain tract of land situated on the headwaters of the Pecos River, in New Mexico, as a public park.	Referred to Committee on Public Lands.

Year.	Congress.	House in which originated.	Object of Bill.	Action taken.
1888	50th, 1st ses.	H. R. 3239, Taylor.	For the preservation of the woods and forests of the national domain adjacent to the sources of navigable rivers and their affluents in the United States.	Referred to Committee on Agriculture.
1888	50th, 1st ses.	H. R. 3279, Oates.	To define and punish the offense of setting fire to and burning woods, grass, or forests on lands belonging to the United States.	Referred to Committee on Revision of Laws. Reported back.
1888	50th, 1st ses.	H. R. 3306, Symes.	For the protection and the administration of the forests on the public domain.	Referred to Committee on Public Lands. Laid on table.
1888	50th, 1st ses.	H. R. 3410, Hatch.	For the preservation of the woods and forests of the national domain adjacent to the sources of the navigable rivers and their affluents in the United States.	Referred to Committee on Agriculture.
1888	50th, 1st ses.	H. R. 6045, White (N.Y.)	For the protection and administration of the forests of the public domain.	Referred to Committee on Public Lands. Laid on the table.
1888	50th, 1st ses.	H. R. 6709, Symes.	To amend an act entitled "An act authorizing the citizens of Colorado, Nevada, and the Territories, to fell and remove timber on the public domain for mining and domestic purposes." Approved June 3, 1878.	Referred to Committee on Public Lands.
1888	50th, 1st ses.	H. R. 7901, Holman.	To secure to actual settlers the public lands adapted to agriculture, to protect the forests on the public domain, and for other purposes.	Reported by Committee on Public Lands as a substitute for H. R. bill No. 6045 and other bills relating to the public lands. Passed. In Senate referred to Committee on Public Lands.
1888	50th, 1st ses.	H. R. 8006, Committee on Indian Affairs.	To amend section 5388 of the Revised Statutes of the United States in relation to timber depredations.	Passed House. Referred to Senate Committee on Indian Affairs. Reported back. Passed Senate. Examined and signed. Approved by President.
1888	50th, 1st ses.	H. R. 9055, Symes.	To establish a public park to be called and known as the Royal Arch Park.	Referred to Committee on Public Lands.
1888	50th, 1st ses.	H. R. 11037, Holman.	To set apart a certain tract of land in the Territory of New Mexico as a public reservation.	Referred to Committee on Public Lands.
1890	51st, 1st ses.	Senate 549, Hale.	For the protection and administration of the forests on the public domain.	Referred to Committee on Agriculture and Forestry.
1890	51st, 1st ses.	Senate 1394, Teller.	Authorizing the citizens of Colorado, North Dakota, South Dakota, Montana, Nevada, and the Territories, to fell and remove timber on the public domain for mining and domestic purposes.	Referred to Committee on Public Lands.

Year.	Congress.	House in which originated.	Object of Bill.	Action taken.
1890	51st, 1st ses.	Senate 1523, Sherman.	For the preservation of the woods and forests of the national domain adjacent to the sources of the navigable rivers and their affluents in the United States	Referred to Committee on Agriculture and Forestry.
1890	51st, 1st ses.	Senate 3139, Stewart.	To authorize the entry of the public lands by incorporated towns for cemetery and park purposes.	Referred to Committee on Public Lands.
1890	51st, 1st ses.	Senate 4156, Committee on Agriculture and Forestry.	For the protection of trees and other growth on the public domain from destruction by fire.	Introduced by Committee on Agriculture and Forestry. Debated. Amended and passed Senate. Referred to House Committee on Public Lands.
1890	51st, 1st ses.	H. R. 705, E. B. Taylor	For the preservation of the woods and forests of the national domain adjacent to the sources of the navigable rivers and their affluents in the United States	Referred to Committee on Public Lands.
1890	51st, 1st ses.	H. R. 4592, Dorsey.	To amend an act entitled "An act for the sale of timber lands in the States of California, Oregon and Nevada, and in Washington Territory," approved June 3, 1878.	Referred to Committee on Public Lands.
1890	51st, 1st ses.	H. R. 5382, Peel.	To dispose of the timber lands of the State of Arkansas at cash entry.	Referred to Committee on Public Lands.
1890	51st, 1st ses.	H. R. 7026, Dunnell.	For the reservation and preservation of forest lands on the public domain and to establish a commission to examine into the condition of the said lands, and to report a plan for their permanent management.	Referred to Committee on Public Lands.
1890	51st, 1st ses.	H. R. 8247, Carey.	To authorize entry of the public lands by incorporated cities and towns for cemetery and park purposes.	Referred to Committee on Public Lands. Reported back. Passed House. Referred to Senate Committee on Public Lands. Reported back with amendment. Amended and passed Senate. House non-concurs in Senate amendment. Conference appointed. Conference report made and agreed to. Examined and signed. Approved by President.
1890	51st, 1st ses.	H. R. 8459, Clunie.	For the protection of watersheds and irrigation systems and for the establishment of a forest administration on the Western mountains and plains.	Referred to Committee on Irrigation of Arid Lands in the United States.
1890	51st, 1st ses.	H. R. 10715, McRae.	To provide for the sale of timber and stone lands and the timber thereon.	Referred to Committee on Public Lands.

Year.	Congress.	House in which originated.	Object of Bill.	Action taken.
1891	51st, 2d sess.	H. R. 12750, Peel.	To dispose of the timber lands of the State of Arkansas at cash entry.	Referred to Committee on Public Lands. Reported back.
1891	51st, 2d sess.	H. R. 13390, Vandever.	To amend "An act to set apart certain tracts of land in the State of California as forest reservations approved October 1, 1890."	Referred to Committee on Public Lands. Reported back.
1892	52d, 1st sess.	Senate 382, Paddock.	For the protection of trees and other growth on the public domain from destruction by fire.	Referred to Committee on Agriculture and Forestry. Reported back adversely and indefinitely postponed.
1892	52d, 1st sess.	Senate 664, Power.	For the sale of timber lands in the State of Montana, and to make the same subject to the mineral laws of the United States after their sale as timber-lands.	Referred to Committee on Public Lands.
1892	52d, 1st sess.	Senate 2763, Paddock.	For the protection and administration of the public forest reservations.	Referred to Committee on Agriculture and Forestry. Reported back adversely and indefinitely postponed.
1892	52d, 1st sess.	Senate 3090, Sanders.	Providing for an experimental forestry tree-culture reserve.	Referred to Committee on Agriculture and Forestry. Reported back adversely and indefinitely postponed.
1892	52d, 1st sess.	Senate 3235, Paddock.	To provide for the establishment, protection and administration of public forest reservations, and for other purposes.	Referred to Committee on Agriculture and Forestry. Reported back with amendments.
1892	52d, 1st sess.	H. R. 29, Peel.	To dispose of the timber lands of the State of Arkansas at cash entry.	Referred to Committee on Public Lands. Laid on table.
1892	52d, 1st sess.	H. R. 102, Holman.	To secure to actual settlers the public lands adapted to agriculture, to protect the forests on the public domain, and for other purposes.	Referred to Committee on Public Lands.
1892	52d, 1st sess.	H. R. 338, Enochs.	For the preservation of the woods and forests of the national domain adjacent to the sources of the navigable rivers and their affluents in the United States	Referred to Committee on Agriculture.
1892	52d, 1st sess.	H. R. 2647, Caminetti.	For the protection of trees and other growth on the public lands and on the public parks and reservations of the United States from destruction by fire.	Referred to Committee on Agriculture.
1892	52d, 1st sess.	H. R. 5979, Hermann.	Regulating the manner and limitation of tree culture.	Referred to Committee on Public Lands.
1892	52d, 1st sess.	H. R. 6656, Committee on Public Lands.	To provide for the sale of stone and timber lands unfit for cultivation and for other purposes.	Introduced by Committee on Public Lands as substitute for H. R. 5142 and 29. Laid on table.

Year.	Congress.	House in which originated.	Object of Bill.	Action taken.
1892	52d, 1st sess.	H. R. 8259, Peel.	To dispose of the timber lands of the State of Arkansas at cash entry.	Referred to Committee on Public Lands.
1892	52d, 1st sess.	H. R. 8445, Otis.	To repeal the act of October 1, 1890, in relation to forest reservations in California, and instructing the Secretary of the Interior to issue patents to settlers thereon.	Referred to Committee on Private Land Claims.
1892	52d, 1st sess.	H. R. 9709, McRae.	To classify timber lands and provide for the sale of the timber thereon.	Referred to Committee on Public Lands.
1893	52d, 2d sess.	Senate 2275,	For the relief of purchasers of timber and stone lands under the act of June 3, 1878.	Passed House. Examined and signed.
1893	52d, 2d sess.	H. R. 9790, Hermann.	For the relief of purchasers of timber and stone lands under the act of June 3, 1878.	Referred to Committee on Public Lands.
1893	52d, 2d sess.	H. R. 9981, Harvey.	Reserving the timber reservation in Oklahoma Territory for the benefit of the Territorial institutions of learning.	Referred to Committee on Public Lands.
1893	52d, 2d sess.	H. R. 10101, McRae.	To protect public forest reservations.	Referred to Committee on Public Lands. Reported back.
1893	52d, 2d sess.	H. R. 10207, Townsend.	To provide for the protection and administration of public forest reservations, and for other purposes.	Referred to Committee on Public Lands.
1894	53d, 1st sess.	Senate 74, Dolph.	To provide for the classification and disposition of the public lands, the protection and administration of the public forest reservations and for other purposes.	Referred to Committee on Public Lands.
1894	53d, 1st sess.	Senate 612, Squire.	Authorizing citizens of that part of the State of Washington eastward of the Columbia River to fell and remove timber on the public domain for mining and domestic purposes.	Referred to Committee on Public Lands.
1894	53d, 1st sess.	H. R. 119, McRae.	To protect public forest reservations.	Referred to Committee on Public Lands. Reported back with amendments. Debated. Withdrawn.
1895	53d, 2d sess.	Senate 2069, Washburn.	To amend the act of June 3, 1878, for the sale of timber and stone lands.	Referred to Committee on Public Lands.
1895	53d, 2d sess.	H. R. 119, McRae.	To protect public forest reservations.	Recommitted to House Committee on Public Lands. Reported back with amendments. Resolution making bill special order reported, debated, and withdrawn.

Year.	Congress.	House in which originated.	Object of Bill.	Action taken.
1895	53d, 2d sess.	H. R. 4726, Lynch.	For the relief of citizens who have entered lands under an act entitled, "An act for the sale of timber lands in California. "Nevada, Oregon and Washington Territory," approved June 3, 1878, and to amend said act and all acts amendatory thereof.	Referred to Committee on Public Lands. H. R. 7359 reported as substitute.
1895	53d, 2d sess.	H. R. 5714, Baldwin.	To amend an act entitled, "An act for the sale of timber land in the States of California, Oregon, Nevada and Washington Territory."	Referred to Committee on Public Lands. Reported back. Debated.
1895	53d, 2d sess.	H. R. 7173, Bell.	To provide for the reduction of the limits of Battlement Mesa forest reserve, in the State of Colorado.	Referred to Committee on Public Lands.
1895	53d, 2d sess.	H. R. 7259, Committee on Public Lands.	For the relief of certain settlers who have entered lands under the timber and stone act, etc.	Introduced by Committee on Public Lands as substitute for H. R. 4726. Passed House. Referred to Senate Committee on Public Lands. Reported back.
1895	53d, 2d sess.	H. R. 7854, McRae.	To prevent the free use of timber on the public lands and to revoke all permits heretofore granted in certain States, and for other purposes.	Referred to Committee on Public Lands. Reported back with amendment.
1895	53d, 2d sess.	H. R. 7918, Houk.	Authorizing bona fide settlers on public lands to cut timber therefrom, and for other purposes.	Referred to Committee on Public Lands.
1895	53d, 3d sess.	Senate 2571, Kyle.	To create a forestry commission.	Referred to Committee on Forest Reservations.
1895	53d, 3d sess.	H. R. 119, McRae.	To protect public forest reservations.	Debated in House. Amended and passed House. Referred to Senate Committee on Public Lands. Reference changed to Committee on Forest Reservations. Reported back with amendment. Amended and passed Senate. Referred to House Committee on Public Lands. Conference appointed. Report made and withdrawn.
1895	53d, 3d sess.	H. R. 7259.	For the relief of certain settlers who have entered lands under the timber and stone act, etc.	Passed Senate. Examined and signed.
1895	53d, 3d sess.	H. R. 7854,	To prevent the free use of timber on the public lands and to revoke all permits heretofore granted in certain States and for other purposes.	Debated amended and passed House. Referred to Senate Committee on Public Lands.

Year.	Congress.	House in which originated.	Object of Bill.	Action taken.
1895	53d, 3d sess.	H. R. 8323, Coffeen.	Making an additional appropriation to meet the expenses of protecting the timber on the public lands for the fiscal year ending June 30, 1895.	Referred to Committee on Appropriations.
1896	54th, 1st ses.	Senate 914, Teller.	To protect public forest reservations.	Referred to Committee on Forest Reservations.
1896	54th, 1st ses.	Senate 1214, Squire.	To appropriate funds for investigations and tests of American timber.	Referred to Committee on Agriculture and Forestry.
1896	54th, 1st ses.	Senate 1349, Davis.	For the relief of applicants to purchase public lands under the timber and stone act.	Referred to Committee on Public Lands.
1896	54th, 1st ses.	Senate 1632, Berry.	To permit owners of claims to iron and coal mines on forest reservations of the United States to perfect their titles thereto, and to procure a patent therefor, and for other purposes.	Referred to Committee on Public Lands. Reported back with amendments. Amended and passed Senate. Referred to House Committee on Public Lands. Reported back with amendment.
1896	54th, 1st ses.	Senate 1803, Berry.	To repeal section 8 of an act entitled, "An act to repeal timber-culture laws, and for other purposes," approved March 3, 1891.	Referred to Committee on Public Lands.
1896	54th, 1st ses.	Senate 2118, Allen.	To protect public forest reservations.	Referred to Committee on Forest Reservation and Protection of Game. Reported back. Passed over in Senate.
1896	54th, 1st ses.	Senate 2946, Dubois.	To protect and administer the public timber lands.	Referred to Committee on Forest Reservations and Protection of Game.
1896	54th, 1st ses.	Senate 2963, Pettigrew.	To amend sections 18, 19, 20, and 21, of the act entitled, "An act to repeal timber-culture laws, and for other purposes," approved March 3, 1891.	Referred to Committee on Public Lands.
1896	54th, 1st ses.	H. R. 14, Hermann.	For the relief of purchasers of timber and stone lands under the act of June 3, 1878.	Referred to Committee on Public Lands. Reported back adversely and laid on table.
1896	54th, 1st ses.	H. R. 40, McRae.	To prevent the free use of timber on the public lands for commercial use and for other purposes.	Referred to Committee on Public Lands.
1896	54th, 1st ses.	H. R. 119, McRae.	To protect public forest reservations.	Referred to Committee on Public Lands. Reported back with amendment. Passed House. Referred to Senate Committee on Forest Reservations and Protection of Game.

Year.	Congress.	House in which originated.	Object of Bill.	Action taken.
1896	54th, 1st ses.	H. R. 832, Shafroth.	To protect the forests on the public domain from destruction by fire.	Referred to Committee on Public Lands.
1896	54th, 1st ses.	H. R. 2280, Shafroth,	To open the forest reservations of the State of Colorado for the location of mining claims.	Referred to Committee on Public Lands. H. R. 4991 reported as substitute.
1896	54th, 1st ses.	H. R. 4058, Doolittle.	To set apart certain lands, now known as the Pacific Forest Reservation, as a public park, to be known as the Washington National Park.	Referred to Committee on Public Lands. Reported back with amendment. Amended and passed House. Referred to Senate Committee on Forest Reservation and Protection of Game.
1896	54th, 1st ses.	H. R. 4065, Towne.	For the relief of applicants to purchase public lands under the timber and stone act.	Referred to Committee on Public Lands.
1896	54th, 1st ses.	H. R. 4067, Towne.	To amend an act entitled, "An act for the sale of timber lands in the States of California, Oregon, Nevada, and in Washington Territory," approved June 3, 1878.	Referred to Committee on Public Lands.
1896	54th, 1st ses.	H. R. 4336, Doolittle.	To extend the mineral land laws of the United States to lands embraced within reservations created by Presidential proclamation, and for other purposes.	Referred to Committee on Indian Affairs
1896	54th, 1st ses.	H. R. 4442, Lacey.	To amend the act of June 3, 1878, entitled, "An act for the sale of timber lands in the States of California, Oregon, Nevada, and in Washington Territory," as amended by section 2 of the act of August 4, 1892.	Referred to Committee on Public Lands. Reported back.
1896	54th, 1st ses.	H. R. 4562, Jenkins.	To amend an act entitled, "An act for the sale of timber lands in the States of California, Oregon, Nevada, and Washington Territory."	Referred to Committee on Public Lands.
1896	54th, 1st ses.	H. R. 4901, Committee on Public Lands.	To open forest reservations in the State of Colorado for the location of mining claims.	Introduced by Committee on Public Lands as substitute for H. R. 2280. Debated and passed House. Referred to Senate Committee on Public Lands. Reported back. Passed Senate. Examined and signed. Approved by President.
1896	54th, 1st ses.	H. R. 8730, Hurley.	To appropriate funds for investigations and tests of American timber.	Referred to Committee on Agriculture.
1896	54th, 1st ses.	H. R. 9123, Shafroth.	To prevent forest fires on the public domain.	Referred to Committee on Public Lands. Reported back. Debated and passed House. Referred to Senate Committee on Public Lands.

Year.	Congress.	House in which originated.	Object of Bill.	Action taken.
1896	54th, 1st ses.	H. R. 9124, Shafroth.	To protect the forests on the public domain from destruction by fire.	Referred to Committee on Public Lands. Reported back.
1896	54th, 1st ses.	H. R. 9143, Johnson.	To protect public forest reservations.	Referred to Committee on Public Lands.
1897	54th, 2d ses.	Senate 1632.	To permit owners of claims to iron and coal mines on forest reservations of the United States to perfect their title thereto, and to procure a patent therefor, and for other purposes.	Consideration in House objected to.
1897	54th, 2d ses.	Senate 2118.	To protect public forest reservations.	Passed over in Senate.
1897	54th, 2d ses.	H. R. 9124.	To protect the forests of the public domain from destruction by fire.	Debated and rejected in House.
1897	54th, 2d ses.	H. R. 9123, Towne.	To prevent forest fires on the public domain.	Reported back and passed Senate. Examined and signed. Approved by President.
1897	54th, 2d ses.	H. R. 9923, Towne	To confirm title to purchasers of certain lands under the timber and stone law.	Referred to Committee on Public Lands.
1897	54th, 2d ses.	H. R. 10270, Lacey.	Providing for the selection of lands in lieu of swamp lands included in forest reservations.	Referred to Committee on Public Lands.
1897	54th, 2d ses.	H. R. 10356, Mondell.	To restore to the public domain the lands embraced within the forest reservations in the State of Wyoming set up and established by Executive order February 22, 1897.	Referred to Committee on Public Lands.
1897	54th, 2d ses.	H. R. 4053.	To set apart certain lands now known as the Pacific Forest Reserve, as a public park, to be known as the Washington National Park	Reported back. Passed Senate. Examined and signed.

To give a more complete view of the action of the Government in its bearings upon forestry, it seems proper to append to the foregoing synopsis the following record of legislation, actual as well as only proposed:

TIMBER CULTURE ACTS.

Year.	Congress.	House in which originated.	Object of Bill.	Action taken.
1873	42d, 2d sess.	Senate 630, Hitchcock	To encourage the growth of timber on Western prairies. A person planting 40 acres of timber trees on Government land to be entitled to 160 acres at the expiration of ten years. The so-called timber - culture act.	Referred to Committee on Public Lands. Reported favorably and passed. Approved March 3, 1873.

Year.	Congress.	House in which originated.	Object of Bill.	Action taken.
1874	43d, 1st sess.	H. R. 743, Dunnell.	To amend the above act. Confines privilege of entry to heads of families or persons over twenty-one years of age and to citizens of the United States. Reduces the time for perfecting title to eight years. Restricts the amount to be entered by one person to 160 acres. Allows homesteaders to obtain patent by planting one-sixteenth of homestead with trees.	Passed and approved March 13, 1874.
1876	43d, 1st sess.	H. R. 2427.	To amend act of 1873. Allows extension of time for perfecting title in case of the destruction of trees by grasshoppers; also permits seeds and nuts to be planted instead of trees.	Referred to Committee on Public Lands. Reported favorably. passed and approved May 20, 1877.
1878	45th, 2d ses.	H. R. 3223, Strait.	To amend the act of 1873. Reducing the number of acres to be planted to 10 for every quarter section and in the same proportion for smaller quantities, but requiring closer planting— twenty-seven hundred trees per acre. Five acres to be broken first year and 5 the second, and planted with trees in the third and fourth years. Repeals the homestead provision of the act of 1874.	Reported with amendments by committee, passed and approved June 14, 1878.
1881	47th, 1st ses.	H. R. 430, Ryan.	To amend the act of 1878. Specifying the kinds of trees to be planted.	Referred to Committee on Public Lands.
1882	47th, 1st ses.	H. R. 4497, Deering.	To repeal the act of 1878.....	Referred to Committee on Public Lands.
1885	49th, 1st ses.	Senate 65, Dolph.	To repeal all laws for the pre-emption of public lands and those allowing entries for timber-culture, the sale of desert lands, etc.	Referred to Committee on Public Lands.
1885	49th, 1st ses.	H. R. 452, Cobb.	To repeal all laws for the pre-emption of public lands and those allowing entries for timber-culture.	Referred to Committee on Public Lands.
1885	49th, 1st ses.	H. R. 380, Payson.	To repeal pre-emption and timber-culture laws. Nearly identical with bill 452.	Referred to Committee on Public Lands.
1886	49th, 1st ses.	H. R. 5210, Henley.	To repeal all laws for the pre-emption of public lands and for timber-culture entries.	Referred to Committee on Public Lands.
1886	49th, 1st ses.	H. R. 1238, Strait.	To amend the act of 1878.....	Referred to Committee on Public Lands.
1888	50th, 1st ses.	Senate 2893, Paddock.	To amend an act entitled. "An act to amend an act entitled 'An act to encourage the growth of timber on the Western prairies.'"	Referred to Committee on Public Lands.

Year.	Congress.	House in which originated.	Object of Bill.	Action taken.
1888	50th, 1st ses.	H. R. 1301, Payson.	To repeal all laws providing for the pre-emption of the public lands, the laws allowing entries for timber culture, the laws authorizing the sale of desert lands and for other purposes.	Referred to Committee on Public Lands. Laid on table.
1888	50th, 1st ses.	H. R. 1601, Stone.	To repeal all laws providing for the pre-emption of the public lands, the laws allowing entries for timber culture, and for other purposes.	Referred to Committee on Public Lands. Laid on table.
1888	50th, 1st ses.	H. R. 2003, McRae.	To repeal the pre-emption and timber-culture laws, and to amend the desert-land act, and for other purposes.	Referred to Committee on Public Lands. Laid on table.
1890	51st, 1st sess.	Senate 66, Dolph.	To repeal all laws providing for the pre-emption of the public lands, the laws allowing entries for timber-culture, and for other purposes.	Referred to Committee on Public Lands. Reported back adversely and indefinitely postponed.
1890	51st, 1st sess.	Senate 366, Paddock.	To amend an act entitled "An act to amend an act entitled 'An act to encourage the growth of timber on the Western prairies.'"	Referred to Committee on Public Lands. Reported back. Passed Senate. Referred to House Committee on Public Lands.
1890	51st, 1st sess.	H. R. 84, McRae.	To repeal all laws providing for the pre-emption of the public lands, the law allowing entries for timber-culture and amending other land laws, and for other purposes.	Referred to Committee on Public Lands.
1890	51st, 1st sess.	H. R. 550, Laws.	To amend an act entitled, "An act to amend an act entitled 'An act to encourage the growth of timber on the Western prairies.'"	Referred to Committee on Public Lands.
1890	51st, 1st sess.	H. R. 5404, Pickler.	To provide for the commutation of timber-culture entries.	Referred to Committee on Public Lands. H. R. 7254 reported as a substitute.
1890	51st, 1st sess.	H. R. 5598, Hans- borough.	To repeal the timber-culture act.	Referred to Committee on Public Lands.
1890	51st, 1st sess.	H. R. 7254, Committee on Public Lands.	To repeal the timber-culture laws, and for other purposes.	Introduced by Committee on Public Lands as substitute for H. R. 5404. Debated and passed House. Reported back with amendment. Debated, amended and passed Senate. Referred to House Committee on Public Lands. House non-concurs in Senate amendments. Conference appointed.

Year.	Congress.	House in which originated.	Object of Bill.	Action taken.
1891	51st, 2d sess.	Senate 5129, Plumb.	To amend section 8 of an act approved March 3, 1891, entitled "An act to repeal timber-culture laws, and for other purposes."	Passed Senate. Debated and passed House. Examined and signed. Approved by President.
1891	51st, 2d sess.	H. R. 7254,	To repeal timber - culture laws, and for other purposes.	Conference report made. Debated and agreed to. Examined and signed. Approved by President.
1892	52d, 1st sess.	Senate 1024, Vilas.	To amend chapter 561 of the laws of the second session of the 51st Congress, entitled "An act to repeal timber-culture laws, and for other purposes."	Referred to Committee on Public Lands.
1892	52d, 1st sess.	Senate 1179, Kyle.	To amend section 1 of an act approved March 3, 1891, entitled "An act to repeal timber-culture laws, and for other purposes."	Referred to Committee on Public Lands. Reported back adversely and indefinitely postponed.
1892	52d, 1st sess.	Senate 1248, Dorris.	To repeal section 24 of an act entitled "An act to repeal timber-culture laws, and for other purposes." Approved March 3, 1891.	Referred to Committee on Public Lands. Reported back adversely and indefinitely postponed.
1892	52d, 1st sess.	Senate 2180, Casey.	Declaring the construction of an act entitled "An act to repeal timber-culture laws, and for other purposes." Approved March 3, 1891.	Referred to Committee on Public Lands. Reported back adversely and indefinitely postponed.
1892	52d, 1st sess.	Senate 3281, Hansbrough	To amend section 7 of "An act to repeal timber-culture laws, and for other purposes." Approved March 3, 1891.	Referred to Committee on Public Lands.
1892	52d, 1st sess.	Senate 3393, Pettigrew.	To amend an act approved March 3, 1891, entitled "An act to repeal timber-culture laws, and for other purposes."	Referred to Committee on Public Lands. Reported back with amendments.
1892	52d, 1st sess.	H. R. 412, Pickler.	To amend section 1 of an act entitled, "An act to repeal timber-culture laws, and for other purposes."	Referred to Committee on Public Lands. H. R. 7691 reported as substitute.
1892	52d, 1st sess.	H. R. 7691, Committee on Public Lands.	To amend an act entitled, "An act to repeal timber-culture laws, and for other purposes."	Introduced by Committee on Public Lands as substitute for H. R. 412. Debated.
1892	52d, 1st sess.	H. R. 8702, Halvorson.	To amend an act to repeal timber-culture laws, and for other purposes.	Referred to Committee on Public Lands.
1892	52d, 1st sess.	H. R. 9003, Committee on Public Lands.	To amend section of "An act to repeal timber-culture laws, and for other purposes." Approved March 3, 1891.	Introduced by Committee on Public Lands as substitute for H. R. 2657.
1893	52d, 2d sess.	Senate 2564,	To amend section 6 of the act approved March 3, 1891, entitled "An act to repeal timber-culture laws, and for other purposes."	Reported back.

Year.	Congress.	House in which originated.	Object of Bill.	Action taken.
1894	53d, 1st sess.	Senate 113, Mitchell.	To extend the provisions of "An act to amend section 8 of an act approved March 3, 1891, entitled, 'An act to repeal the timber-culture laws, and for other purposes,'" to all of that part of Oregon lying east of the Cascade range of mountains.	Referred to Committee on Military Affairs.
1894	53d, 1st sess.	H. R. 1986, Kem.	To amend section 6 of an act approved March 3, 1891, entitled, "An act to repeal timber-culture laws, and for other purposes."	Referred to Committee on Public Lands. Reported back. Passed House. Referred to Senate Committee on Public Lands. Reported back. Passed Senate. Examined and signed. Approved by President.
1895	53d, 2d sess.	Senate 1281, Blackburn.	To amend section 7 of "An act to repeal timber-culture laws, and for other purposes," approved March 3, 1891.	Referred to Committee on Public Lands.
1895	53d, 2d sess.	Senate 1696, Wolcott.	To amend an act approved March 3, 1891, entitled, "An act to repeal timber-culture laws, and for other purposes."	Referred to Committee on Public Lands.
1895	53d, 2d sess.	H. R. 4458, Holman.	To amend section 7 of "An act to repeal timber-culture laws, and for other purposes," approved March 3, 1891.	Referred to Committee on Public Lands. Reported back.
1895	53d, 3d sess.	H. R. 4458,	To amend section 7 of "An act to repeal timber-culture laws, and for other purposes," approved March 3, 1891.	Referred to House Committee on Judiciary.
1895	53d, 3d sess.	H. R. 8424, Pickler.	To amend the law relating to final proofs in timber-culture entries.	Referred to Committee on Public Lands.
1896	54th, 1st sess.	Senate 103, Kyle.	Relating to final proof in timber-culture entries.	Referred to Committee on Public Lands. Reported back with amendment; amended and passed Senate. Referred to House Committee on Public Lands. Reported back. Debated, amended, and passed House. Senate concurs in amendments. Examined and signed. Approved by President.
1896	54th, 1st sess.	Senate 1378, Perkins.	To amend an act entitled, "An act to repeal timber-culture laws, and for other purposes," approved March 3, 1891.	Referred to Committee on Public Lands.
1896	54th, 1st sess.	H. R. 2644, Pickler.	To amend the law relating to final proofs in timber-culture entries.	Referred to Committee on Public Lands.

Year.	Congress.	House in which originated.	Object of Bill.	Action taken.
1896	54th, 1st ses.	H. R. 3543, Pickler.	To amend the law relating to final proof in timber-culture entries.	Referred to Committee on Public Lands.
1896	54th, 1st ses.	H. R. 4248, Long.	Granting to certain successful contestants of timber-culture entries the privilege of now exercising their right of entry under the timber-culture act of June 14, 1878.	Referred to Committee on Public Lands.
1896	54th, 1st ses.	H. R. 4694, Long.	To amend section 1 of the act of March 3, 1891, entitled, "An act to repeal timber-culture laws, and for other purposes."	Referred to Committee on Public Lands.
1896	54th, 1st ses.	H. R. 4959, McRae.	To repeal section 8 of an act entitled, "An act to repeal timber-culture laws and for other purposes," Approved March 3, 1891.	Referred to Committee on Public Lands.
1897	54th, 2d sess.	Senate 3328, Pettigrew.	To amend an act entitled "An act to repeal the timber-culture laws, and for other purposes."	Referred to Committee on Public Lands. Reported back. Passed Senate. Referred to House Committee on Public Lands. Reported back with amendments. Debated, amended and passed House. Senate concurs in House amendments. Examined and signed. Senate requests President to return bill. President complies with Senate request. Debated and referred to Senate Committee on Judiciary. Committee discharged, bill reconsidered, and House amendments non-concurred in. Conference appointed. Conference report made and agreed to. Examined and signed.
1897	54th, 2d sess.	Senate 3689, Pettigrew.	To amend an act entitled "An act to repeal the timber-culture laws, and for other purposes."	Referred to Committee on Public Lands.
1897	54th, 2d sess.	H. R. 10314, Gamble.	To amend an act entitled "An act to repeal the timber-culture laws, and for other purposes."	Referred to Committee on Public Lands. Reported back.

FOR THE ESTABLISHMENT AND ENDOWMENT OF FORESTRY SCHOOLS

Year.	Congress.	House in which originated.	Object of Bill.	Action taken.
1882	47th, 1st ses.	Senate 1880, McMillan.	To aid in the endowment of a school of forestry at Saint Paul. Granting 300 sections of public land for the purpose.	Referred to Committee on Agriculture.

Year.	Congress.	House in which originated.	Object of Bill.	Action taken.
1883	47th, 2d sess.	H. R. 7440, Pettigrew.	To grant lands to Dakota for the purpose of establishing a school of forestry. Granting 400 sections of land for the purpose.	Referred to Committee on Public Lands.
1884	48th, 1st ses.	H. R. 4361, Raymond.	To grant lands to Dakota for the purpose of establishing a school of forestry. Same bill as the preceding.	Referred to Committee on Public Lands.
1886	49th, 1st ses.	H. R. 2826, Gifford.	To grant lands to Dakota for the purpose of establishing a school of forestry. Same as two preceding bills.	Referred to Committee on Public Lands.
1895	54th, 1st ses.	Senate 793, Thurston.	To establish and maintain a national school of forestry.	Referred to Committee on Agriculture.
1895	54th, 1st ses.	H. R. 303, Hainer.	To establish and maintain a national school of forestry.	Referred to Committee on Agriculture.

RECENT LEGISLATION.

[The following legislation was embodied in the Sundry Civil Appropriation Bill, which became a law in 1897. This law enables the Secretary of the Interior to formulate a plan for the proper administration of the Forest Reservations, but its provisions can hardly become operative without a sufficient appropriation to carry it into effect. Plans for the survey of the Reserves, as provided in the following law, are now (June 24th) about matured.]

1897. 55th Congress, 1st Session. An Act Making Appropriations for Sundry Civil Expenses, etc., approved June 4, 1897.

The sections of the bill referring to the Forest Reservations are as follows:

"For the survey of the public lands that have been or may hereafter be designated as forest reserves by Executive proclamation, under section twenty-four of the Act of Congress approved March third, eighteen hundred and ninety-one, entitled 'An act to repeal timber-culture laws, and for other purposes,' and including public lands adjacent thereto, which may be designated for survey by the Secretary of the Interior, one hundred and fifty thousand dollars, to be immediately available: Provided, That to remove any doubt which may exist pertaining to the authority of the President thereunto, the President of the United States is hereby authorized and empowered to revoke, modify, or suspend any and all such Executive orders and proclamations, or any part thereof, from time to time as he shall deem best for the public interests: Provided, That the Executive orders and proclamations dated February twenty-second, eighteen hundred and ninety-seven, setting apart and

reserving certain lands in the States of Wyoming, Utah, Montana, Washington, Idaho, and South Dakota as forest reservations, be, and they are hereby, suspended, and the lands embraced therein restored to the public domain the same as though said orders and proclamations had not been issued: Provided, further, That lands embraced in such reservations not otherwise disposed of before March first, eighteen hundred and ninety-eight, shall again become subject to the operations of said orders and proclamations as now existing or hereafter modified by the President.

"The surveys herein provided for shall be made, under the supervision of the Director of the Geological Survey, by such person or persons as may be employed by or under him for that purpose, and shall be executed under instructions issued by the Secretary of the Interior; and if subdivision surveys shall be found to be necessary, they shall be executed under the rectangular system, as now provided by law. The plats and field notes prepared shall be approved and certified to by the Director of the Geological Survey, and two copies of the field notes shall be returned, one for the files in the United States surveyor-general's office of the State in which the reserve is situated, the other in the General Land Office; and twenty photolithographic copies of the plats shall be returned, one copy for the files in the United States surveyor-general's office of the State in which the reserve is situated; the original plat and the other copies shall be filed in the General Land Office, and shall have the facsimile signature of the Director of the Survey attached.

"Such surveys, field notes, and plats thus returned shall have the same legal force and effect as heretofore given the surveys, field notes, and plats returned through the surveyors-general; and such surveys, which include subdivision surveys under the rectangular system, shall be approved by the Commissioner of the General Land Office as in other cases, and properly certified copies thereof shall be filed in the respective land offices of the districts in which such lands are situated, as in other cases. All laws inconsistent with the provisions hereof are hereby declared inoperative as respects such survey: Provided, however, That a copy of every topographic map and other maps showing the distribution of the forests, together with such field notes as may be taken relating thereto, shall be certified thereto by the Director of the Survey and filed in the General Land Office.

"All public lands heretofore designated and reserved by the President of the United States under the provisions of the act approved March third, eighteen hundred and ninety-one, the orders for which shall be and remain in full force and effect, unsuspended and unrevoked, and all public lands that may hereafter be set aside and reserved as public forest reserves under said act, shall be as far as practicable controlled and administered in accordance with the following provisions:

"No public forest reservation shall be established, except to improve and protect the forest within the reservation, or for the purpose of securing favorable conditions of water flows, and to furnish a continuous supply of timber for the use and necessities of citizens of the United States; but it is not the purpose or intent of these provisions, or of the act providing for such reservations, to authorize the inclusion therein

of lands more valuable for the mineral therein or for agricultural purposes than for forest purposes.

"The Secretary of the Interior shall make provisions for the protection against destruction by fire and depredations upon the public forests and forest reservations which may have been set aside or which may be hereafter set aside under the said act of March third, eighteen hundred and ninety-one, and which may be continued; and he may make such rules and regulations and establish such service as will insure the objects of such reservations, namely, to regulate their occupancy and use and to preserve the forests thereon from destruction; and any violation of the provisions of this act or such rules and regulations shall be punished as is provided for in the act of June fourth, eighteen hundred and eighty-eight, amending section fifty-three hundred and eighty-eight of the Revised Statutes of the United States.

"For the purpose of preserving the living and growing timber and promoting the younger growth on forest reservations, the Secretary of the Interior, under such rules and regulations as he shall prescribe, may cause to be designated and appraised so much of the dead, matured, or large growth of trees found upon such forest reservations as may be compatible with the utilization of the forests thereon, and may sell the same for not less than the appraised value in such quantities to each purchaser as he shall prescribe, to be used in the State or Territory in which such timber reservation may be situated, respectively, but not for export therefrom. Before such sale shall take place, notice thereof shall be given by the Commissioner of the General Land Office, for not less than sixty days, by publication in a newspaper of general circulation, published in the county in which the timber is situated, if any is therein published, and if not, then in a newspaper of general circulation published nearest to the reservation, and also in a newspaper of general circulation published at the capital of the State or Territory where such reservation exists; payments for such timber to be made to the receiver of the local land office of the district wherein said timber may be sold, under such rules and regulations as the Secretary of the Interior may prescribe; and the moneys arising therefrom shall be accounted for by the receiver of such land office to the Commissioner of the General Land Office in a separate account, and shall be covered into the Treasury. Such timber, before being sold, shall be marked and designated, and shall be cut and removed under the supervision of some person appointed for that purpose by the Secretary of the Interior, not interested in the purchase or removal of such timber nor in the employment of the purchaser thereof. Such supervisor shall make report in writing to the Commissioner of the General Land Office and to the receiver in the land office in which such reservation shall be located of his doings in the premises.

"The Secretary of the Interior may permit, under regulations to be prescribed by him, the use of timber and stone found upon such reservations, free of charge, by bona fide settlers, miners, residents, and prospectors for minerals, for firewood, fencing, buildings, mining, prospecting, and other domestic purposes, as may be needed by such persons for such purposes; such timber to be used within the State or Territory, respectively, where such reservations may be located.

"Nothing herein shall be construed as prohibiting the egress or ingress of actual settlers residing within the boundaries of such reservations, or from crossing the same to and from their property or homes; and such wagon roads and other improvements may be constructed thereon as may be necessary to reach their homes and to utilize their property under such rules and regulations as may be prescribed by the Secretary of the Interior. Nor shall anything herein prohibit any person from entering upon such forest reservations for all proper and lawful purposes, including that of prospecting, locating, and developing the mineral resources thereof: Provided, That such persons comply with the rules and regulations covering such forest reservations.

"That in cases in which a tract covered by an unperfected bona fide claim or by a patent is included within the limits of a public forest reservation, the settler or owner thereof may, if he desires to do so, relinquish the tract to the Government, and may select in lieu thereof a tract of vacant land open to settlement not exceeding in area the tract covered by his claim or patent; and no charge shall be made in such cases for making the entry of record or issuing the patent to cover the tract selected: Provided further, That in cases of unperfected claims the requirements of the laws respecting settlement, residence, improvements, and so forth, are complied with on the new claims, credit being allowed for the time spent on the relinquished claims.

"The settlers residing within the exterior boundaries of such forest reservations, or in the vicinity thereof, may maintain schools and churches within such reservation, and for that purpose may occupy any part of the said forest reservation, not exceeding two acres for each schoolhouse and one acre for a church.

"The jurisdiction, both civil and criminal, over persons within such reservations shall not be affected or changed by reason of the existence of such reservations, except so far as the punishment of offenses against the United States therein is concerned; the intent and meaning of this provision being that the State wherein any such reservation is situated shall not, by reason of the establishment thereof, lose its jurisdiction, nor the inhabitants thereof their rights and privileges as citizens, or be absolved from their duties as citizens of the State.

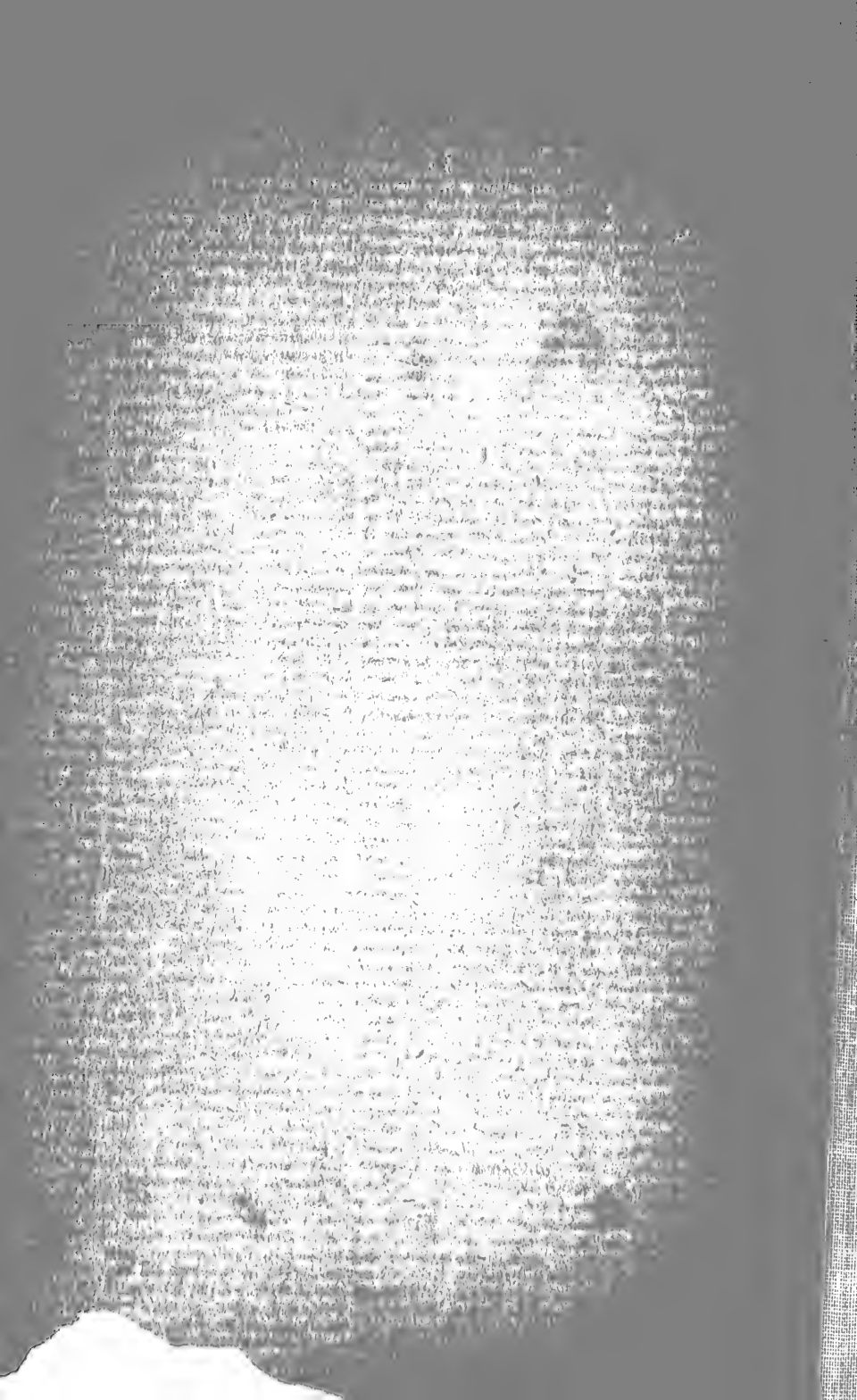
"All waters on such reservations may be used for domestic, mining, milling, or irrigation purposes, under the laws of the State wherein such forest reservations are situated, or under the laws of the United States and the rules and regulations established thereunder.

"Upon the recommendation of the Secretary of the Interior, with the approval of the President, after sixty days' notice thereof, published in two papers of general circulation in the State or Territory wherein any forest reservation is situated, and near the said reservation, any public lands embraced within the limits of any forest reservation which, after due examination by personal inspection of a competent person appointed for that purpose by the Secretary of the Interior, shall be found better adapted for mining or for agricultural purposes than for forest usage, may be restored to the public domain. And any mineral lands in any forest reservation which have been or which may be shown

to be such, and subject to entry under the existing mining laws of the United States and the rules and regulations applying thereto, shall continue to be subject to such location and entry, notwithstanding any provisions herein contained."

"The President is hereby authorized at any time to modify any Executive order that has been or may hereafter be made establishing any forest reserve, and by such modification may reduce the area or change the boundary lines of such reserve, or may vacate altogether any order creating such reserve.

THE
 END
 OF
 THE
 WORLD



PROCEEDINGS
OF THE
American Forestry Association



AT THE
Special Meetings at Asheville, N. C. and Nashville, Tenn.
September 17-22; 1897,

TOGETHER WITH AN ADDRESS ON
The Forests and Deserts of Arizona,
(BY B. E. FERNOW, LL. D.)

BEFORE A JOINT MEETING OF THE
American Forestry Association with the National Geographic
Society.

VOLUME XII.

WASHINGTON, D. C.
1897.



ANNOUNCEMENT.

The Executive Committee has the pleasure of announcing to the members of the American Forestry Association that with this issue of Proceedings the plan of publication heretofore followed will be abandoned, and in its stead there will be established a monthly magazine, which it is believed will better serve as a medium of communication between members and the public, and prove a more useful and constant exponent of the ideas for which the Association stands.

With this 12th volume of the Proceedings, containing the accounts of the annual and summer meetings of the current year, all papers read before the Association and intended for publication are disposed of, and thus the new plan of publication is inaugurated with a cleared table.

It is hoped that the members of the Association throughout the country will aid the new enterprise, which is to begin on the first of January, 1898, with contributions and news items, and make of it in fact, as in name, the mouthpiece of the American Forestry Association.

For the Executive Committee,

B. E. FERNOW,
Chairman.

NOTE.—Contents of this volume at end of publication.

PROCEEDINGS
OF THE
American Forestry Association



AT THE
Fifteenth Annual Meeting,
Washington, February 5, 1897,
AND
Special Meetings at Asheville, N. C. and Nashville, Tenn.
September 17-22, 1897,

VOLUME XII.

WASHINGTON, D. C.
1897.

NOTICE.

With this volume XII. the publication of the Proceedings in special volumes will for the present be discontinued, the monthly journal, "The Forester," taking the place of the Proceedings. The series of volumes published is as follows: Those marked * are out of print; the remainder is for sale at prices set opposite on application to the Forestry Div., U. S. Dept. of Agriculture, which has undertaken to act as distributing agency for these publications; discounts to Libraries and Public Institutions.

- *Vol. I.—Proceedings of the special meeting at Montreal, August, 1882. Papers read before the meeting printed separately by the Canadian Government in the Ontario Fruit Growers' Report. (The proceedings of the first annual meeting, held in Cincinnati, April 25-29, 1882, were not published in pamphlet form.)
- *Vol. II.—Proceedings of the second annual meeting, at St. Paul, August, 1883. Also, Forestry Bulletins No. 1 (May, 1884); No. 2 (September, 1884); No. 3 (January, 1885).
- *Vol. III.—Proceedings of the special meeting at Washington, D. C., May, 1884, and third annual meeting, at Saratoga, New York, September, 1884.
- *Vol. IV.—Proceedings of the fourth annual meeting, held in Boston, September, 1885.
- *Vol. V.—Proceedings of the fifth annual meeting, held at Denver, Colorado, September, 1886. (Newspaper report.)
- *Vol. VI.—Proceedings of the sixth annual meeting, held in Springfield, Illinois, September, 1887.
- Vol. VII.—Proceedings of the seventh annual meeting, held at Atlanta, Ga., December, 1888, and of the eighth annual meeting, held at Philadelphia, Pa., October, 1889. (About 70 copies on hand.)
- Vol. VIII.—Proceedings of the summer meeting, held in Quebec, September, 1890, and of the ninth annual meeting, held in Washington, D. C., December, 1890. (About 400 copies on hand.) 50 cents.
- *Vol. IX.—Papers read at joint session of the American Economic Association and the American Forestry Association, held at Washington, D. C., December, 1890.
- Vol. X.—Proceedings at the tenth, eleventh, and twelfth annual meetings, held in 1891, 1892 and 1893, and of the special meeting at the World's Fair Congress in Chicago in 1893. (Published in four parts. Of these there are on hand, Part 1, 400 copies; Part 2, 1,700 copies; Part 3, 1,400 copies; Part 4, 1,300 copies.) 75 cents, or 25 cents a part.
- Vol. XI.—Proceedings at the Thirteenth and Fourteenth Annual Meetings, December, 1894, and January, 1896, at Washington, and at the summer meetings at Brooklyn, N. Y., and Springfield, Mass. Published in three parts. Of these there are on hand: Part 1, 1,100 copies; Part 2, 1,400 copies; and Part 3, 1,800 copies.) 75 cents, or 25 cents a part.
- Vol. XII.—Proceedings at the Fifteenth and Annual Meeting, February, 1897, and summer meetings at Asheville, N. C., and Nashville, Tenn. (Published in two parts.) 50 cents each part.

THE FORESTS AND DESERTS OF ARIZONA.

[An Illustrated Lecture Delivered Before a Joint Meeting of the American Forestry Association and the National Geographic Society at Washington, D. C., February 5, 1897.]

By B. E. FERNOW, L.L.D.

The horizon of the majority, even of those who have made hasty overland trips, rarely reaches beyond the few hundred square miles of their personal observation, and as to the possibilities of the future—even those who have studied our past development fail to realize them. Our imagination—save in the professional boomer—lags behind reasonable expectation.

When I told my friends that a happy accident—the invitation of a generous and public-spirited friend—would take me for the summer months to and through Arizona, two expressions were most frequent: one of commiseration at my prospects of summer temperatures, the other a somewhat astonished inquiry as to what a forester could find of interest in that country of cactus and desert. That a large part of the territory of Arizona can boast of an ideal summer climate, unequaled for camping, was a revelation to them; and that some of the most interesting mountain forests, botanically speaking, are to be found there, and the most lovely and most extensive, as well as most economically important pineries that exist between the great forests of the Pacific Coast and the western border of the Atlantic forest in Texas and Arkansas, a thousand miles away in either direction—this seemed to them almost incredible.

Why should this particular forest area become a subject of investigation? Here is a territory still undeveloped, still undeveloped, for the larger part; a territory needing for its best future development not only the material which these forest areas can furnish forever, but dependent on irrigation for its agricultural future, and thus requiring that protection of its water sources which a forest cover is supposed to afford. Would it not be wisdom to study the relation of this resource to the whole development of the country, and to study the conditions, under which this resource could be rationally managed, so as to avoid

as far as practicable the devastation that has characterized our occupation of other sections, and thus pave the way for a rational use of this important yet limited resource? To be sure, this is hardly the way we are wont to do, for with regard to our resources, especially our forests, we take a position somewhat similar to that of the gentleman from Arkansas: "When it was raining he could not mend his roof, and when it was not he did not need a roof anyway."

And why should a *forester* undertake such an examination? Because he is or ought to be specially fitted for it by his studies; because finally his business has the closest relation direct and indirect to the economic development of all other interests, because he must be a practical economist. For a forester is not, as the American public is prone to believe, one who studies or knows or even who plants trees, nor even he who has the technical knowledge to produce and manage forest crops (a *sylviculturist*), but he must combine with that technical knowledge, a knowledge of the proper relation of his art to all other economic interests, he must be a student of economic conditions generally, a promoter of the rational use of natural and national resources.

So much it seemed needful to say in explanation of the propriety of bringing before a forestry association an account of things which may appear at first of distant interest to its purposes, however much interest they may have to members of a geographical society.

Arizona, the unknown and maligned; the land of thorns and spines; the province of apparently hopeless deserts, and yet of rich promise; the land of dreary wastes, and yet of infinite variety and contrasts; the territory most picturesque and full of interest to the geologist and botanist and ethnologist, even to the mere sight-seer, and yet the least visited; the earliest discovered of the western territories, and yet the last to pass from the red-man's dominion, and the least developed; the land of a high prehistoric civilization, of cave dwellers and cliff dwellers, and of the peaceful agricultural Hopi and Pima, and yet—until a decade ago terrorized by the most warlike of the Indians, the Apache—Arizona is one of the most interesting of all our provinces.

It is curious that the health-inspiring, rejuvenating quality of Arizona's dry air did not impress itself upon the Spanish seekers of the Fount of Eternal Youth, one of whom was destined, while balked in his search for the latter, to first set foot on this part of the continent. Alva Nunez Cabeza de Vaca, with two Spaniards and one Indian Negro as companions, all four fugitives by land from slavery among the Seminole Indians in Florida, and finding their way across the continent, were the first to see the "Seven Cities of Cibola," the Hopi villages; were the first to pass under the shadows of San Francisco Mountains and to share the hospitalities of the Pima Indians, just 360 years ago. Three years later (in 1540) an exploring expedition under Vasquez de Coronado visited the same country, and it was then that one of his lieutenants, Don Garcia Lopez de Cardenas, gazed—the first white man—on the wonders of the Grand Cañon of the Colorado. Forty years later another of the conquistadores, Antonio de Espejo, ventured forth, and claimed and named the country, for Spain, Neuvo Mexico, under which name it came to the United States; the portion north of Gila river by the treaty of Guadalupe Hidalgo in 1847, the portion south of the Gila by the treaty and purchase negotiated by the then Minister to Mexico, James Gadsden, in 1854, for the purpose of obtaining a suitable route for a Southern Pacific railroad; the price paid for the latter portion being \$10,000,000, and the guaranty that we would protect the Mexican frontier against the raids of the Apaches.

In 1863 the Territory of Arizona was segregated from New Mexico, the name probably being a modification of *Arizonac*, a Papago Indian name of uncertain meaning, which had been applied to a native village and was extended to the lower portion of what is now our southwestern province by the Spaniards.

Spanish development was confined entirely to the lower portions, and consisted mainly in the establishment of missions to convert the agricultural Indians, and in the location of presidios at Tucson and Tubac to protect the missions and the few haciendas and silver mines then worked; the hostile Apache constantly harassing their Indian and Spanish neighbors alike, and withstanding the progress of civilization.

The expeditions of the War Department under Sitgreaves, Williamson, Whipple, Parke, Gray, Beale, and Ives, during the

years from 1852 to 1860, give us the first definite knowledge of the country. Almost simultaneously with these, immigration and mining development began, under protection of military forts Buchanan and Breckinridge.

From 1863, when the territory was segregated from New Mexico, to 1874, the history of Arizona is written in blood. It took a hardy man to run the risk of tomahawk and scalping knife in order to benefit from the rich mineral discoveries in southern and middle Arizona. Nor were the mining communities themselves without their internal strife and shot-gun administration of desperadoes and Mexican laborers. The successful campaigns of General Custer, however, broke the war spirit of the Indians, and led to the treaty of 1874, when these Indians were placed on reservations. The advent of the Southern Pacific Railroad in 1878 stimulated anew the development of the mining districts, and since the Apache Indians, with their cunning leader, Geronimo, were removed to Florida in 1886, the peaceful progress of territorial development is assured, and one may travel through the country with no more fear of a hold up than in Texas or New York.

Three centuries and three-score years of history! Yet the beginnings of civilization and development of the territory date back hardly a score of years, and it is only a little over a decade since a really peaceful progress has begun, since the marauding Apache has been removed!

Arizona, with an area of about 114,000 square miles—equaling the combined areas of New York and the New England States, or of Ohio, Indiana, and Illinois—is, in the main, a plateau rising from the southwestern corner toward the north and east. From an altitude of not more than 40 feet above sea-level at or near Yuma, the plateau level rises to 7000 feet or more, and, with the many mountain ranges that over-top the plateau, every altitude is found, up to 12,800 feet, in the rude stone monument erected by Mr. Gilbert on the highest peak of San Francisco Mountains. There is, however, a convenient and significant altitudinal sub-division of the plateau to be noted by which the northeastern section with about one-third of the territory, is segregated, as the Colorado plateau—a part of the great plateau which extends northward—with an average elevation of over 4000 feet, the southwestern two-thirds forming a lower plateau

with an average elevation of probably over 1000 feet, studded with rugged sierras which sometimes reach up nearly 10,000 feet. The division between these sections is sharp and sudden; in most parts it is a line of cliffs and steep slopes varying from 600 to 1200 feet and more in height, which form a rim to the higher plateau, popularly known among the Mexicans as the Mogollon, and among Americans as "the rim." This great escarpment forms so abrupt a boundary line that a stone may be hurled from one region into the other. Immediately below this rim there is a climatically and botanically intermediary region or transition zone which only accentuates the two main divisions.

The convenience of this sub-division extends beyond topographic distinction, for the two sections differentiate climatically almost as abruptly as the surface, giving rise, from the standpoint of the visitor, to a summer section and a winter section, with corresponding differences in flora, fauna and economic conditions. Thus the range of summer and winter climate which latitudinal difference of a thousand miles effects from Maine to Florida, is here effected approximately by altitudinal differences within a hundred miles.

Furthermore, the two sections are best reached, and until a few years ago could only be approached, by rail on two independent railroad systems—the Southern Pacific, affording passage through the southern section, and the Atlantic and Pacific (now part of the Santa Fe system), traversing the northern section. At present there is a connection between the two trunk lines by way of Phoenix and Prescott, giving access to the central section. These three lines, with a few short feeders, comprise the entire railroad system of the territory.

The tourist starting for Arizona in July will probably enter the territory by the northern route, and spend the warm months on the plateau, making Flagstaff his headquarters or base of supplies. After the dreary and hot ride over the featureless plains of western Kansas and eastern Colorado and through the hardly less dreary though more varied mountain scenery of New Mexico, and after passing through the desert country of the eastern border county of Arizona (containing the celebrated petrified forests, strewn in huge logs over the sandy waste), it is a relief when suddenly the Piñon and juniper ap-

pear in dense masses, and finally the pine forest is entered within an hour of reaching Flagstaff. To add to the feeling of comfort and new interest which this unexpected forest scene creates, the grand peaks of the San Francisco Mountains come in sight, possibly with a white veil of freshly-fallen snow that vanishes before the day is over. Then, when the heavy upgrade puffing of the engine, and the rumbling of the cars cease, and we alight at the terminus of the railroad journey and the beginning of your camping tour in the oddly-named town—Flagstaff—in the midst of this lovely pinery, we feel at home at once, without misgivings as to the comfort and interest of the expedition.

Coming to study the forests, we are naturally attracted by the chimneys and lumber piles in the distance, which suggest what becomes of the grand pines that you have just learned to admire. Although the sun is low—the train arriving late in the afternoon—the saw mills of the Arizona Lumber Company, which, with the cattle and sheep interests, form the *raison d'être* of the little settlement of 1500 people, call for immediate inspection. At the mills and offices we learn that of the 24,000,000 feet of lumber now cut in the territory annually, the various saw mills of Flagstaff, supplied by a logging road of 20 miles, produce about one-half, besides some 200,000 railroad ties, supplying the local demands of the northern part of the territory and also of southern California and New Mexico. We learn, from inspection of the yards, that the pine lumber (*Pinus ponderosa*) is only of medium quality, yet good enough for all local uses. With a lumberman's eye we have noticed that the trees cannot yield much clear timber, and this impression is verified by the books of the saw mill men, which show that not more than 6 to 7 per cent. of the logs reaching the mill yield first-class material; and we have also noted that the cut per acre must be far below what eastern lumbermen would expect. These conditions are fully realized in Flagstaff. The opinion of the president of the Arizona Lumber Company, Mr. D. M. Riordan, the vice-president of our Association for the Territory, conveyed to the Governor of the Territory and printed by him in his Report for 1893, is suggestive:

I believe that it is the duty of every person who can give the matter thought and who is in position to influence anyone's action in the prem-

ises, to make some endeavor to perpetuate our forest conditions for the benefit of future generations in the territory. Upon the rational use of our forests will depend the happiness and welfare, and, I may say, the absolute existence of any *large* population in this territory; and the time to act is the present, when the least possible injury will be done to vested rights.

I believe the Government ought to withdraw all timber lands it possesses, and ought to appoint a competent forester, who would make it his sole duty to see that the covering which nature has afforded our mountain tops should be preserved, to the end that the valley land of the territory be protected either from droughts or floods in the years to come.

The next morning we are naturally eager to start out early and climb that grand mountain, which rises north of the little hamlet in solitary grandeur, once a huge volcano whose fires have but recently been extinguished, now unique in its symmetrical and striking outlines, the most impressive feature in the landscape. The elevation of Flagstaff being about 7000 feet, a steady ascent is made from the town for ten or twelve miles to the foot of the cone at 8000 feet, and then comes a steeper climb. The road is through a lovely forest of Bull Pine (*Pinus ponderosa*), a species common from British Columbia southward, both along the Sierra Modoc and the Rocky Mountains down to Mexico. The forest is open and parklike, the trees standing in groups, with here and there an old stager which was a good-sized sapling when the first white conquistadores passed through this wilderness 360 years ago. The open stand of the stately pines rearing their heads 100 and more feet into the remarkably blue sky naturally causes the formation of a long and rather symmetrical crown which adds to the scenic beauty, but not to the commercial value of the timber. Since the rainy season has not yet set in, there is but little grass and lower vegetation visible; hardly any undergrowth impedes the view; yet here and there a clump of the scrubby Rocky Mountain White Oak (*Quercus gambelii*) forms a pleasing contrast.

As we reach an altitude of 9000 feet a change of scene occurs; the yellow-green, heavy-foliaged bull pine is supplanted by the graceful dark green white pine of the Rockies (*Pinus flexilis*) and the still more striking Douglas Spruce, which in scattered individuals studs the now really grassy slope, for at this higher

altitude more moisture and less evaporation favor the grassy growth. One thousand feet higher and we reach the region of the Foxtail pine (*Pinus aristata*), well named, for the long, flexible branchlets, closely beset at their ends with crowded needles, exhibit strikingly the appearance of a fox's tail. As we ascend, the Englemann Spruce, as widely distributed over the West as the Bull Pine, joins these trees, and with them forms a more or less dense forest, the trunks short and much branched and gnarly, of little or no economic value. Here we find also in a few individuals a beautiful fir, a new accession to our flora, which Dr. Merriam has this summer described as the Arizona Cork Fir (*Abies arizonica*), from specimens gathered on this very trip from this very tree. At 11,500 feet the last Englemann Spruce, tousled and shorn by the wintry blasts at this high elevation, and low creeping junipers denote timber line. Toward the northeast we look down into what was once an enormous volcano, one side blown out; the three peaks are still above us.

A short climb of a thousand feet more over large blocks of lava or gravelly detritus brings us to the top of Humphrey's peak. From here the eye sweeps over a goodly portion of the northern part of the Territory, and the vast expanse of the pine land can be traced. Toward the north stretches the Coconino forest, flanking the Grand Cañon, whose sheer walls on the opposite side are dimly discerned. Eastward and northeastward the color of the clouds indicates the position of the Painted desert, separated from the San Francisco forest by a fringe of junipers and Piñons at the levels between 6000 and 7000 feet; toward the south and southeast, far as the eye can imagine sight—to the Mogollon and White Mountains—and westward, beyond the three-peaked landmark of Bill Williams Mountain and Mount Sitgreaves, stretches the sea of pines, covering altogether an area of not less than 3000 square miles.

It is proper that we should give full consideration to San Francisco Mountains, for not only are they among the most picturesque, of interest to the sightseer and geologist and plant geographer, but they are of importance economically; not only for the pasturage that might be gleaned from their slopes, not for the timber which on the higher levels is not worth the cutting, but for their meteorological effect, which is increased by the forest cover. Their peaks arrest and precipitate the clouds,

which would otherwise pass over the plateau and find no cause for precipitation over the eastward desert. Nu-va-ti-ky-óbi (Home of the High Snows) is the name the Indians give to them. They form the only elevation in Arizona on which snows may and do accumulate, giving up their stores in spring, furnishing supplies for many springs and washes and to at least one perennial stream—Oak Creek. From this consideration it would be proper to make into a forest reservation all the area above the 8500 feet.

We may take our descent on the western face of the mountain, passing one of the loveliest spots, where a never-failing spring of cold, delicious water invites us to camp among the aspen growth which intermingles with the spruces and white pines; and we may also extend our excursion to pay a brief visit to Walker Lake or to Crater Lake, whose yawning mouth, once spouting molten masses, is now sealed by a sheet of water, a welcome find to the cattle herds, roaming over the plateau to pick the sometimes scanty herbage.

Water, even on the plateau, is the one deficiency of the whole territory. Not that there is not sufficient and even too much at times, but in its distribution it is uncertain and extreme, both by localities and by season, and even, within the rainy season, the dry air makes constant and excessive demands.

Here, as in the southern portion of Arizona, there are two wet seasons, winter and summer. On the plateau, after the beautiful days of Indian summer in November, winter begins with Christmas; while mostly clear and calm with temperatures rarely below 22 degrees at night, ranging to 50 or 60 degrees in the day, snows come every ten to fourteen days in a depth of 4 to 24 inches, drifting badly, but rarely lying long except on the higher levels, and even the frozen ground becomes soft in the middle of the day. Spring begins about the middle of April, and is the dry season, windy, dusty, the first half cooler, the last half warmer than one would wish. With the first week of July the rainy season sets in, lasting until September. With it comes the profusion of flowers which is characteristic of the Rocky Mountains, and which, by and by, will fill the pine woods below with gay beauty and luxuriance. Whole fields of the Blue Flag (*Iris versicolor*) bloom; there are magnificent carmine *Gilias* and *Pentstemons*, the dark purple and golden *Primula parryi*, the

Yellow Columbine, and a host of others, changing off through the season and making this plateau a veritable flower garden.

The rains hardly ever come as land rains, but their nature and their quantity is very variable. A short shower each afternoon is said to be the regulation rain, but the season of 1895 excelled in terrific down-pours with most boisterous thundering and brilliant lightning, not even respecting the nightly rest of the tentless camper. Yet the dry air soon obliterates the dampness. The temperature, however, is kept at a most delightful, uniform degree, never much above 75 or 80 degrees, and the sunsets after a late thunderstorm are the most gorgeous to be seen anywhere. The nights are cool, toward morning occasionally even cold; altogether the summer climate in the pines is ideal.

While preparing for our trip of exploration there are many points of interest around Flagstaff to visit.

We may descend into Casino or Walnut Cañon, a deep, narrow cut, with its long rows of cliff dwellings built into the limestone walls, reminding us of by-gone milleniums, when a teeming population must have lived here. These dry ridges and plateau portions are wooded, with the low trees, rarely over 30 feet high, often shrublike in form, of the Piñon or Nut Pine (*Pinus edulis*), whose sweet seeds are gathered for food by the Indians, and, the western juniper (*Juniperus utahensis*), fit only for firewood, interspersed with shrubs of striking form and foliage, almost always spiny and of peculiar interest. Among these are the pink-flowered locust, the yellow-flowered prickly-leaved barberry, the fruit making excellent jam, the trifoliate red-fruited squawberry, of delicious acid taste, and the snowy white-tufted cliff rose, which is not a rose at all, yet fills the air with a rare fragrance.

An inspection of the logging operations gives an opportunity to make measurements of the rate of growth of the pines and to observe the differences in their development, giving rise to the lumberman's classification into jack pines, the younger or quickly grown, and yellow pines, the older or slowly grown, which are from 250 to 300 years and more old.

Presently we start southward, looking back on the hospitable town of Flagstaff and its grand mountain and forest entourage, across the waste which the logger and the unavoidable forest

fire have made, and the natural prairie or glade south of it. Such glades, from a few acres to several square miles in extent, are a very general and interesting phenomenon throughout these woods, furnishing not only most pleasing vistas, but opportunity for pasturage and agricultural use. Their soil is usually rich black loam washed from the surrounding hills, rather compact and liable to a wide range of moisture conditions on account of deficient drainage, and hence inimical to tree-growth, but readily supporting a greensward of grass. These depressions in wet seasons sometimes turn into lakes. Mormon Lake, which we pass, is such a prairie some five miles long and one to two miles wide, which, when the Mormons arrived there, made the appearance of a rich meadow, inducing them to settle and go into dairy farming; after a few years the glades filled up with water and became a lake; in 1895 it was all dry except a small remnant of water in the lowest depression. As these patches of fertile land, forming about 15 to 20 per cent. of the forested area, are destined to become objects of agricultural development—they have begun to be so used—and in that way will be helpful in the rational management of the surrounding forest country, it would be of interest to experiment as to their best treatment; many of them by judicious ditching, by which the moisture extremes may be abated, can undoubtedly be made to produce varied crops besides the potato and alfalfa or oats, which the short season and the cold condition of the soil now permit.

As we proceed we presently pass a most forbidding spot, where the limestone soil is covered with black blocks of lava, giving rise to soils locally known as *malapai*, corrupted from the Spanish *Mal país* (bad lands), although the soil is not so bad, after all, at least for tree growth. One of the great lava fields of the world, made up of basalt and trachyte, extend from San Francisco Mountains southward and northward, covering fully 20,000 miles with its overflow.

As we progress through the forest we learn from the differences of soils and consequent differences in development of the trees something of the geology of this plateau. Archæan, Silurian, Carboniferous, Jurassic, Cretaceous and Ligneous rocks are found. Three soil formations are readily recognized, limestone here, sandstone there, and over both irregularly the decomposed beds of lava, which have overflowed thousands of

square miles, giving rise to the malapai. So far as tree-growth is concerned, wherever the decomposition of the lava blocks has been thorough and limestones have added their quota, the soil is by no means unfavorable; the limestone soils seem to produce the best timber, the sandstone soils the poorest.

Water is to be found in springs only at rare intervals, and hence camping places must be known, yet the few wells which have been dug here and there, furnishing deliciously cool and good water, suggest that the development of water resources could be extended.

As we become familiar with the woods and observe how the trees always stand in groups with open spaces between, and how the young growths from the seedling to the sapling also occur only in groups and patches, and as we lie in our tentless bed in an open spot, where neither cones nor caterpillars can drop on us, and ponder over the reasons for this aspect of tree distribution, we come to the conclusion that water conditions, or soil conditions affected by drainage, must account for it. Those portions of the rocky and unevenly disintegrated soil, which permit a temporary storage at the proper season of sufficient moisture, will alone reproduce and permit the young growth to thrive. Another interesting observation regarding these pine forests is that young growth seems to appear only in irregular periods, from three to ten years intervening between the groups of young trees. After a fortnight's progress of the rainy season, millions of little seedlings spring up all through the wood, carrying their seed-shells in the characteristic manner above ground, a rich promise of a dense young aftergrowth, yet probably all doomed to perish by frost, because the short season does not permit the ripening of their wood. The reproduction, to be permanent, must take place in the early spring, induced by a wet winter and spring season, which occurs only at considerable intervals.

The farther south we progress on our journey the denser, statelier and more valuable grows the pine forest, undisturbed as yet by the hand of man. Presently we emerge from its shady recesses, and as we pass the last pines a candelabrum of flaming yellow and red lights—a century plant in bloom, messenger of warmer climes that has found its way up along a cañon from the lower levels—tells us that soon we shall be in the region of Cactus, Yucca and Cat's Claw.

If we had time we would visit those picturesque red rocks, which loom up in the west, forming the cañons of Oak creek, the perennial daughter of San Francisco Mountains, the clearest mountain stream of this part of the world, in its upper part famed for beautiful trout pools. In its middle part, hardly known to even the nearest neighbors and not at all to the outside world, it affords the most romantic and most picturesque rock country imaginable, the celebrated Garden of the Gods in Colorado being an insignificant imitation only. The manifold curious wind-carved shapes of the red sandstone rocks rising abruptly from the ground, contrasted with the green of the surrounding plain, are worth a long journey. The few who have visited this secluded valley will also not forget the remarkable bouquet and aroma of the grape raised by one of the more enterprising ranchers on these sun-warmed sand bottoms, which promises some day to outrank the finest vintage of Bordeaux.

Presently a wide view opens before our eyes; far below us stretches the Verde valley, and we are looking over the rim into the border land of the southern desert region. In red and white and yellow and brown tints glare the arid gravels, studded thinly with a scant shrubby vegetation, dry and gray. The fresh, bright green spots that catch the eye we find afterward to be groups of opuntias, large prickly pears, whose red acid fruit we appreciate later in the season, after we have learned how to avoid the prickles which almost invisibly cover them in small tufts.

Among the trees, the first we meet is a peculiar, leafless shrub-like form, with long, slender green branches, the falsely so-called Palo Verde (*Canotia holacantha*) of the botanists. The majority of the shrubs of the brush desert belong to the Acacia tribe, all with symmetrically rounded heads, and, like every other plant here, provided with thorns or spines, the peculiar adaptation to desert conditions making the labors of the collector a hard task. Many unfamiliar plant forms excite the curiosity of the new-comer.

We have suddenly dropped to the 3000 foot level and begin to feel the difference in temperature; the canteen is often called into requisition. By and by the heat of the early afternoon sun leads us to wish that camp were near. Uncertain of the road, we ascend one of the glaring white limestone hills, and lo, what an

unexpected sight meets our eye! the contrast is so great that we think a mirage must have risen to mock our heated brain. There lies at our feet, stretching away for several miles, a land of green vegetation, rich and luscious as in the most favored spots of the Alleghanies in early summer, a broad river of foliage interrupted here and there by fields of alfalfa and corn, with orchards from which the red roofs peep out hospitably. We are looking into the valley of Beaver creek, one of the affluents of Rio Verde, which, like all these water courses, hidden away under a dense cover of deciduous trees, are the surprises of the deserts through which they flow, and furnish the water for the irrigated fields of the rancher. Here we find not only the cottonwoods, Hackberry and ash of several species, as along the streams of the more eastern plains, but a tree alder of excellent shape, peculiar to Arizona, and a plane or sycamore much more beautiful and striking in its foliage than those which are planted in our eastern streets and parks. There is the same tangle of luxuriant vegetation, with grape vines trailing over bushes and trees, that we find in the bottom lands of our Gulf States, with rock and debris and driftwood and sand carried by the flood waters of the stream which comes from the pine plateau—the forest watering the plain. Down in this bower of green, a real paradise after the weary desert ride, we gladly camp and enjoy a refreshing bath in the soda springs.

In addition to the creek and these interesting soda springs, there is a still more remarkable sheet of water to be found in the well-known Montezuma well, a deep hole in the limestone hills, probably originally a large limestone cave, the roof of which fell in, when the water collected in it. Here also we find reminders of the cliff dwellers, who, a thousand years ago or more, built their abodes in the walls of this huge well and used its never-failing water, which passes through a subterranean tunnel into the creek, to irrigate his fields, just as the rancher of today. Not only the line of the ancient ditch was found clearly defined, but the petrified ditch itself has been dug out, the lime of the water having completely filled the original ditch with its deposit.

A thrifty agricultural population, with whom agriculture and especially horticulture evidently pays, has now taken the place of these prehistoric tillers of the soil, who have left the

signs of their existence and their activity everywhere through the territory in more or less preserved ruins, the largest and most elaborate of which, named Montezuma castle—probably because of its size and elaborateness—is found not many miles from Montezuma well. Little is known of these prehistoric people, but after seeing the present abodes and ways of the Hopi and Zuni Indians, there remains but little doubt in our minds that the ancients were ancestors of these aborigines, perhaps not so many centuries removed; and observing that these cliff dwellings are as a rule situated near or overlooking agriculturally available grounds, and recalling the history of the Apache raids, we conclude that they were agricultural Indians driven to construct their dwellings in inaccessible places for defense against their enemies.

Resuming our journey, a few miles brings us to Verde, the abandoned military post known as Camp Verde, where 2000 of the wild Apache surrendered to General Crook in 1883, then and there breaking the war spirit of the race which had harassed for centuries peaceful Indians and white settlers alike. Except in the irrigated valley, everything looks brown and sere and uncompromising under the July sun, but when we passed this way again in September, after the rains have had opportunity to be effective, the country was almost unrecognizable; the dry brush desert had changed into a beautiful prairie, and for the first time in eight years the grass had grown large enough to cut for hay. The cattle industry used to thrive in this valley, as in many others of the Territory, and also on the plateau; but just like lumbering in other regions, it was carried on recklessly, the natural meadows being overstocked far beyond their capacity, so that large areas which twelve years ago were luxuriant grass producers, are now absolutely barren, with not a spear of grass visible.

The broad valley of Rio Verde, which carries the drainage from the plateau to Salt River, is capable of agricultural development to a much greater extent than has been attempted; but, as in other parts of the Territory, this requires systematic storage and utilization of the water. By careful management the cattle, sheep and goat industry would no doubt be able to use advantageously the large non-irrigable areas. The home market for this secluded valley is mainly in Jerome, which is the

seat of one of the largest copper mines and reduction works in the United States, with an annual output of about one million dollars in value. Prescott, and the mining districts surrounding it, are also within reach by a long day's ride.

There is hardly a drearier ride to be imagined than that from Verde valley over the Black Hills to Prescott. Up and down hill, over dry ridges, studded with chapparal, Scrub Oak, Manzanita and the like, but for the mineral wealth that may be under ground, we traverse a region for which no use suggests itself. Arriving at Prescott, we reach once more the altitude of the pines in Bradshaw Mountains; but we find that there is little timber left, the town and the mining districts surrounding it having used up most of it. Prescott was once the capital of the Territory, and is still the metropolis of central Arizona, the supply base of many outlying mining districts and cattle ranches in the large valleys on the north and west.

Here we may take train for the southern portion of the Territory. A branch road starts from Ash Fork on the Atlantic & Pacific Railroad, whence it passes through the Black forest—not of spruces, firs and pines, like as the celebrated forest of that name in Germany, but of sombre low-topped cedars and piñon—the road running over trestles and loops to get from the plateau into the valley. Passing southward from Prescott on this line, we traverse a rugged, dry mountain country, which contains rich mining ground where a man may wash his days' wages in gold from the soil anywhere in the mostly dry creek bottoms or canons. Deficiency of water alone retards this mining development. Yet some large mines are worked by pumping water six and eight miles over the mountains.

As we descend into the plain from the 6000 foot level of Prescott the temperature seemingly rises in geometric ratio; and as we reach the plain at about 1200 feet, we begin to suspect our friends were right, after all, in commiserating our fate. We reach Phoenix at night, and the broad waters of Salt river in the moonlight at least suggest coolness; and the night, warm enough to sleep outdoors, does indeed afford relief from the excessive heat of the day, when the thermometer was at 110 degrees.

The southern portion of Arizona can be sub-divided into two sections fairly well differentiated topographically, climatically

and economically. The eastern district is elevated and mountainous; it is bounded on the west by the high mountain ranges of Santa Ritas, El Rincon, Santa Catalina, and Tortilla and Superstition Mountains. The western part is a vast desert plain out of which, like islands from the sea, rise abruptly in parallel lines, 10 to 30 miles apart, in black and purplish hues, rugged and towering granite mountains reflecting the sun's rays with dazzling brilliancy. These mountains are mostly devoid of vegetation and mostly also of soil, awful in their barrenness, while the desert below may be just as barren in places or else is studded with the sparse vegetation of cacti, Agave, Yucca, Cat's Claws, Palo Verde, Mesquite, etc., a paradise of spines and thorns. There would appear on general principles nothing more depressing than such a country; so it is when viewed from the car window, yet as a matter of fact to the explorer it is full of interest, a stimulus to the curiosity and furnishing real entertainment; and finally much of this hopeless desert promises to the future many a paying enterprise. Not only do the desert mountain ranges contain minerals of value, gold and silver and others, while salt, borax, gypsum, sulphur, asbestos, kaolin, and pummicestone may be found in the plain, but the soil is capable of producing profusely in this southern clime, if only water can be brought to it. Water is the great problem here. The little rain that falls over the vast region fills the water courses, where there are any, for only a few hours, after which what is not evaporated sinks into the loose sand, and the river continues underground, the bed above "running dry." Yet as to the possibility of finding water enough to irrigate the most of it, who will foretell?

There are really only two rivers which run always full—the Colorado and the Gila. While Gila river, with its affluents, the San Pedro, Salt and Hassayampa, which run dry occasionally, furnishes only a limited quantity, the mighty Colorado river carries a volume of water not only six times as rich in fertility as that of the Nile, but of almost limitless and continuous supply, which would suffice to irrigate several million acres, its volume being greatest at the very time when most needed. To be sure, the bed lies considerably below the level of the plain, yet when the economic conditions of the country require it, there will be no difficulty in devising the mechanical means to bring

this water upon the land, as is being done now in a small way at Yuma.

And with the addition of artesian wells, perhaps, it may only be a question of time when these dreary wastes will be turned into fertile fields and gardens such as are beginning to grow up around Phoenix, Yuma and elsewhere, a revival of bygone times, when an ancient and industrious people occupied the Gila bottom lands, of whose existence now only the ruins of long fallen towns, the remnants of large aqueducts, and fragments of widely distributed pottery testify. We may readily indulge in the expectation that some day the dreary sands around Yuma and among many of the barren mountain ranges will assume as pleasing an aspect as that which was presented to us by two neighboring farms, an oasis of incredible productiveness, located within a few miles from town. Coming with empty hands, in two years these toilers, with the aid of climate and water, had become independent lords of their possessions, with several thousand dollars in bank.

Phoenix, the capital, now boasts already of being a garden spot, all owing to the extensive irrigation canal system which derives its waters from Salt river, and certainly the green alfalfa fields and extensive orchards of peach and almond, olive and pomegranate, are a most pleasing contrast to the surrounding cheerless brush desert. The city, embowered in the tropic foliage of palms and pepper trees, with its luxurious hotels, is bound to become, nay, has already become, a Mecca of the seeker after a mild winter climate and relief from pulmonary complaints. While its summer temperatures may be said to lack nothing in generosity, for eight months in the year the climate is said to be perfect.

Tucson, lying 2400 feet above sea-level at the eastern border of the desert, is the rival of Phoenix, not indeed with regard to agricultural development, for this old presidio of the Spaniard placed there to protect the mission of San Xavier among the Papago Indians, still in existence, lies high and dry beyond sufficient water supplies unless some time artesian wells may be developed; but it is or will be a rival as a health resort, excelling the capital in the conditions and quality of the air helpful in pulmonary diseases.

The eastern mountain region, with its mesalike valleys, is mainly a pasturing region; the valleys are clothed with hardy

grass and stunted acacias, while the mountains, when over 6000 feet high and massive enough to induce precipitation, are wooded; the drier exposures and lower altitudes support an open growth of stubby live oaks, the trees varying in height from 12 to rarely over 25 feet, which in the distance make the appearance of an old apple orchard. Higher above the 6000 foot level and reaching to the tops at 10,000 feet at most, the pines appear, including several most interesting species which are at home further south in Mexico, together with some of more northern nativity. In these mountains, within a day's ride from Tucson, we may find the most lovely, cool recesses of a trout stream, either in the Santa Catalina mountains, or, with a few hours of railroad added, in the Chiricahua mountain range, where we may readily forget that we are in the driest and hottest—erroneously so believed—portion of the United States. Here at the higher elevations among the pines the air is most delightful, and while the days are just about right, the nights may, even in September, be frosty enough for a double blanket.

Returning to the plateau of northern Arizona, there are two trips which we must take together from Flagstaff, for without them a visit to the territory is decidedly incomplete; one to and through the Painted desert to the villages of the Hopi Indians, the other to the Grand Cañon.

Having heard that within three days the celebrated snake dance is to take place at Oraibi, one of the Hopi villages 100 miles northward, we get ready our camp outfit for a plunge into the desert. Once more we skirt the San Francisco mountains, which will remain our guide and landmark through the whole trip, visible at any time and to the last. Once more we pass through the pine forest and over the black lava sands of the juniper and pinon belt coming out on the rocky limestone plateau, with its scanty pasture and low shrub growth.

Water is scarce on this trip, and although spring wells and so-called tanks—clayey soil depressions and rock cavities in which rain waters collect—may be found at distances of 25 to 40 miles apart, it is safer to carry water in the approved fashion. We reach the river, the Colorado Chiquito or Little Colorado, marked in the distance by the line of cottonwoods, on the morning of the second day, and find its bed, which is usually dry, filled to the brim with a yellow loam puddle, a rushing torrent.

We would have to camp here until the flood abates, but for the enterprise of an Indian trader, who has spanned the river by a steel cable, on which we transfer our packs, swimming our horses. Now we have entered in truth a desert, such as we have met nowhere else in the territory.

The scene is one of utter desolation. Not a tree or a shrub breaks the monotony of the flat table land; here it is eroded into deep, dark, varicolored green, blue and yellow brown ravines and chasms, there overtopped by high mesas with flaming red edges, the sands reflecting the sun's rays in a white and yellow glare, and the white summer clouds in turn reflecting not only the heat but the colors of the desert. In the distance peculiarly-shaped purplish peaks and pinnacles and solitary buttes mark the limit of the desert proper, and our destination two days hence; while now and then a mirage brings into view a sheet of water so distinct and natural that in spite of our knowledge of the immaterial nature of the apparition our eye refuses to accept the reasoning of our minds. Now and then we pass over different soils, alkali in nature, and still more forbidding than the sand; then again heavy loam soils, with scant brush growth. If there ever was a region, which would be thought beyond the possibilities of useful occupation, you would think that this was the one, and yet as we reach the trading post of the enterprising German, whose cable helped us over the river, we are as ready to distrust our eyes, believing to see a mirage, as when we found ourselves deceived in the phantasmal lakes—but there certainly seem to be green cornfields.

We find that we are not deceived; there is real corn of various kinds, and sugar cane and potatoes and other garden truck, not less than 40 acres in cultivation, right in the sand and without irrigation.

Listen to what the enterprising cultivator writes of his success in the first year's experiment: "Our crop has furnished us 80 tons of hay and fodder; sugar cane did the best, 8 feet high; corn, the old Indian variety, has done well; watermelons, onions and sweet potatoes seem to be at home here, and all that without a drop of rain for 18 months. Our trial plantings have fully paid us. Now we have a lake here, made by construction of a mud-dam across a dry wash, and filled by the floods from the upper country, 1x1½ mile in extent, and 20 feet deep; the

reservoir was filled about September 15, and has lowered until now (January 3) hardly 15 inches. Irish potatoes were small, but perhaps would have made good-sized tubers but that they were drowned; yet we caught ducks in return, which we shot from our boat. The cottonwoods planted have done well; expect to plant 10,000 this spring. There are a million acres around me which can do the same."

How is it possible, you ask, without water? It is due to the moisture held in storage from occasional rains and drainage by the sand, whose structure prevents its evaporation as well as its sinking away. Who will foretell the possibilities of the future?

After this experience, we are not surprised to find further on the cornfields of the Navajo Indians, on the sandiest sites, much more primitive, to be sure, and when we reach the village of Oraibi, the thrifty fields, small garden patches, and peach orchards show that these sands and dry deserts can yet support a goodly population.

Here we are at last after a weary ride over the sand and through the cornfields and bean patches of the Hopi Indians—called Moki by alien tribes in opprobrium and by some whites through objectionable imitation—at the base of a precipitous mesa, perched on which, 300 feet above, stands Oraibi, one of the "Seven Cities of Cibola," where for hundreds, perhaps thousands, of years the original race of Indians has lived peacefully, closely packed in their stone houses. There can be no more picturesque sight than this town and its inhabitants, clad in blankets of bright colors, grouped on the tops of the gray limestone houses, watching the snake dance; nor is there anything more fascinating ~~for us~~ than to watch these ceremonies. There is hardly a more promising field for ethnological study than these primitive house builders and agriculturists, but they are foreign to our chief subject. Yet we may take a glimpse at a few features, in rapid succession.

This has been a festive time, and hence the usual filth has been somewhat removed and general house-cleaning and cleaning of hair and body has taken place, so that inspection of the interiors, which the good-natured children of nature rather court, is comparatively satisfactory. The wealthier householders have even whitewashed their houses outside and inside,

and their stores of corn are in ship-shape order. // The ceremonies of the snake dance last nine days in all, partly in public, partly in their secret temples, where as a rule only the priests of the two orders—the Antelope and Snake—are admitted. To-day is the last day, and the snake dance is the end of the ceremonies, the purport of which is to bring rain for the suffering crops. The Antelope priests, painted, masked and decorated, coming from their kiva in single file, perform a rhythmic round march, and place themselves on guard before the snake hut made of cottonwood boughs, in which the reptile partners to the dance are placed. The snake priests perform the same round march, and then, placed in rows opposite each other, the two lines begin a low incantation accompanied by rhythmic motions in unison, sidewise, to and fro.

Weird is their song, weird are their looks, and weird their motions, but weirder still all these when their wriggling, writhing partners enter the circle and the round march with the snakes begins. For this the snake priests divide into sets of three, the carrier holding the reptile, venomous or not, and in full possession of its fangs, between his teeth, and, rhythmically swinging its curling body; the charmer following him with eagle feathers, stroking the hair and shoulder of the carrier or else his burden; while the catcher trips on the outside, ready to pick up with unfailing accuracy the reptile; when it has done its service, it is laid on the ground and darts away for liberty. The dexterity with which this act is performed, the man taking time to first strew the sacred meal and apply the charm of eagle-brush to the escaping rattler, makes the catcher the hero of the hour. When all these 20 or 30 reptiles have thus passed through the rite, it only remains to carry them toward the north, south, east and west, whence they came, and set them free; unhurt, for they are the personified spirits of ancestors, who have in the ceremony been induced to intercede with the deities.

The result of the prayer for rain, which is the purport of the whole ceremony, seemed to follow immediately in a most tremendous downpour, which turned the dry wash at which we are encamped into a raging torrent 60 feet wide and 5 feet deep; this result, however, was promptly disclaimed by the snake priests, for their prayer is for gentle rain, a drizzle, as it were, which they rarely get.

We must hurry away for our last trip, the one by which we shall always remember Arizona—if all else were forgotten—the Grand Cañon of Colorado river.

A flying stage from Flagstaff brings us in a long day's ride, yet not a dreary one, through the pine woods past San Francisco mountain, again through the cedars, over open mesas and through pine woods once more to a neat tent city, a hotel establishment well fitted to its surroundings, and well kept, nestled in a depression among the stately pines close to the cañon. We are within a hundred steps of the object of our visit, but there is no indication of its presence; nothing but commonplace landscapes, albeit in the lovely setting of the shady pine boughs. We ascend the slope, unsuspecting what it is that makes people who have seen it so unreasonably effusive when speaking of it. And then suddenly the sight bursts upon you; the earth has sunk away at your feet to illimitable depths.

The first sensation is one of awe and bewilderment; a shock, a sense of oppression, perhaps of horror, overpowers you. There is nothing you have seen before that has given you even a hint of what this is; nothing you can compare it to. It is an innovation in nature, which it takes time to comprehend, to appreciate. Then, as you gaze, grows on you a realization of the enormousness, the gorgeousness, the weirdness, the grandeur, majesty and sublimity of the scene. Speechless you gaze on the vast sea of ghostly giant shapes, and you are overcome by the feeling of your own insignificance as in the presence of infinity. Only gradually you are made fully conscious that you behold the most sublime of all earthly spectacles. Here is the time when a man may well pray: "O Lord, forgive me, that I have exhausted my vocabulary before I saw this, your masterpiece."

No picture has ever conveyed an idea; language there is none that can ever give an adequate conception of the ensemble of this great chasm, its vast proportions, its intricate plan, the nobility of its architecture, its colossal buttes, its wealth of ornamentation, the splendor of its rich colors. It is not a cañon at all that you see—the word belittles the scene; it is a labyrinth of an infinite number of chasms and cañons that press themselves upon your view all at once, a mighty mountain country filled with most fantastically carved gigantic rock masses, cy-

clopian castles thousands of feet in height, gracefully towering gothic cathedrals, round-topped Moslem mosques, Greek and Indian temples, frowning rock cities, pyramids and obelisks, battlemented fortresses, all the wonders of the Arabian nights multiplied and heaped together in a wild chaos, stimulating your fancy beyond its power.

And not only ^{is} the ensemble present the most stupendous sight; even the least imposing portions of the cañon are as impressive as any scenery that can be found in the world.

It should be a gratification to the members of the American Forestry Association, that the law, which was secured by their efforts, empowering the President of the United States, to set aside forest reservations, was taken advantage of to set aside for the use of the people forever and to debar from vandalism, not only the surrounding forest, but to include in it this unique and most sublime masterpiece of nature.

For 200 miles of the river bed, with a breadth of 10 to 12 miles and more, is here revealed the interior of the workshop of nature and the secrets of the building up of our earth's crust. The surrounding plateau country is scored by intricate mazes of side cañons. In these and in the main chasm to a depth of 6000 to 8000 feet, geological history is exhibited in precipitous walls with a clearness unparalleled in any portion of the world, telling of eons of rock-building and of milleniums of rock carving by wind and water. Far below, hardly recognizable if at all visible from above, flows the great river which in its ceaseless rush has carried to the sea the sands and debris, results of the denudation of more recent formations, has cut through the pale grey limestones of the Permian, the pink and brilliant red sandstones and the purplish and vermillion limestones of the Triassic, the deep brown rocks of the Carboniferous, down to the sombre iron black granites of the Silurian and Archaean ages, through which the river now rolls its yellow waters, gathered from thousands of square miles in the mountains of Colorado and the plateaus of Utah and Arizona; here in placid and majestic dignity, there with a wild current in roaring rapids over boulders and rocks and precipitous falls.

"Great as is the fame of the Grand Cañon of the Colorado, the half remains to be told," wrote Major Dutton in 1881, in his superb monograph on the cañon; and this is still true today,

and will be for many years. While its geology has been unfathomed with considerable detail by that philosophical geologist, we have but fragmentary knowledge of its flora and fauna, and we have hardly dared yet to think of its undiscovered wealth of minerals and economic possibilities.

We arrive at the brink on Sunday night; a thunderstorm has left a deep black nimbus, a dense glowering sheet in the sky to the east, on which two beacon lights appeared, the bases of an unfinished rainbow, standing straight like two sentinels on each rim of the cañon. To the west the sinking sun paints the horizon in deep crimson, surrounded ^{by} with a golden glory, each one a cluster of small black clouds, while in the north a wild, yellow hail-cloud casts its lurid glare. It was in this setting that through rising mists in purplish hues the mystery of the cañon, awful in the utter stillness, revealed itself to us—"a thought of God on earth expressed," all meaner thoughts expelling.

Whatever may become of Arizona in the future, it will always be known to the world as the country of the Grand Cañon, the wonderland of the South. — *but to us*

SPECIAL MEETINGS AT ASHEVILLE, N. C., AND NASHVILLE, TENN.

At the invitation of the authorities in charge of the Tennessee and International Exposition, a special meeting of the Association was called at Nashville, Tenn. An invitation to stop over on the way to Nashville at Asheville, and to visit the Biltmore estate, in order to inspect the forestry operations conducted under the charge of Dr. C. A. Schenck, was also accepted.

Accordingly, in response to a circular prepared and sent out by the Recording Secretary, a small party assembled at Washington, D. C., on Thursday, September 16, and proceeded thence to Biltmore, N. C., Asheville, N. C., Chattanooga, Tenn., and Nashville, Tenn. Stops were made at all these points, and special meetings of the Association were held at Asheville and Nashville. The party returned to Washington, September 25.

On Friday afternoon and Saturday morning, September 17 and 18, visits were made to the Biltmore estate of Mr. Geo. W. Vanderbilt, under the guidance of Dr. C. A. Schenck, chief of the Forestry Department of the estate. Elaborate preparations had been made by Dr. Schenck, increasing the regret that so few members of the Association were present to enjoy his kind attentions. Carriages for all, printed guide books and maps, paths cut through the forests, with sign posts at intervals, a complete exhibit of woods, tools and photographs in the ball-room at the hotel in Asheville, and the charming hospitality and refreshment extended by Dr. and Mrs. Schenck at their pleasant home, "Woodcote," impressed upon the party the careful forethought that had been exercised. The two routes traversed on Friday afternoon and Saturday morning, respectively, gave full opportunity for seeing the work of the Forest Department, of Biltmore. The forest is divided into four ranges, each in charge of one man, who acts as forester, gamekeeper, watchman, foreman of day laborers and overseer of contractors. The forest operations include planting with seeds and young plants, improvement, cuttings and prunings, building wood roads, filling gullies with wickerwork and brush, trapping beetles in the pine woods, establishing nurseries, both permanent and "wandering," and so forth. The agricultural operations are modified by the necessity of retaining some trees for landscape effects.

The party spent Friday night at the Battery Park Hotel, at Asheville. In the evening a meeting was held in the ball-room, Mr. J. D. W. French in the chair. Dr. Schenck made a short address on Forest Finance, and afterward explained the exhibit which was displayed on tables around the room and decorated the floor and walls. Among other things, he showed a series of white pine seeds germinating in pots, charts showing the lumber to be expected per acre under different conditions, and pyramids formed of cross sections of trees taken at intervals of six feet, and showing that by the difference between the number of rings in the large bottom section and any other smaller section above it, the time is noted which the tree took to grow to the height of the given upper section. There were also many photographs showing the results of forestry methods, pictures of lumber camps, an assortment of tools used by the

rangers, and a handsome display of specimens of woods grown on the estate.

Mr. Jas. H. Best, of the Southern Railway, then read a paper prepared by Mr. M. V. Richards, the Land and Industrial Agent of the Southern Railway, discussing the importance of wood to the human race, and citing many instances where it is still indispensable.

On motion of Mr. Haskell, a vote of thanks was tendered Dr. Schenck for his delightful courtesies and his able paper.

Saturday afternoon the party traveled through the beautiful scenery along the French Broad River, arriving late at night at the Lookout Inn, on Lookout Mountain, where Sunday and part of Monday were spent.

Neighboring battlefields were visited and the forests of the vicinity were studied. The kind attentions of Mrs. B. L. Goulding and Mr. Geo. M. Bradt, of the Chattanooga Chamber of Commerce, added greatly to the pleasure of the visit.

Monday evening the party arrived at Nashville, making the Maxwell House headquarters.

Tuesday evening the local committee of arrangements met the gentlemen of the party at the hotel, and settled the details of the programme for the meeting.

Wednesday, September 22, the Association met at the Children's Building, in the grounds of the Nashville Centennial Exposition. Col. E. C. McDowell called the meeting to order at 10.30 A. M. He hoped the people of Tennessee would get a more practical knowledge of forestry from this meeting. He excused the absence of Major Thomas, the president of the Exposition, and introduced in his place Col. J. D. Killebrew, who welcomed the Association very cordially, dwelling upon the peculiar fitness of Tennessee for such a meeting.

The president of the Association being unavoidably absent, Vice-President French, of Massachusetts, responded, thanking Colonel Killebrew for his kind words of welcome. He called attention to the manner in which the forests have been wasted, and thought the time had come for promoting their growth instead of their destruction. He advocated a Government school of forestry in the South and West.

Mr. George B. Sudworth, of the Division of Forestry in the Department of Agriculture, read an interesting paper on "The

Forest Flora and Conditions of Middle and East Tennessee."

Col. J. D. Killebrew followed with a paper on the "Forests of Tennessee."

On motion of Vice-President Riordan, of Arizona, the Association requested the newspapers of the State and of the lumber trade to publish this paper.

Owing to the illness of Mr. D. W. Baird, editor of the *Southern Lumberman*, a paper prepared by him was read by Mr. H. B. Bond, of Nashville. Mr. Baird discussed the "Effects of Forest Denudation on Water Courses and Water Supply for Man and Beast."

A recess was then taken until 3.30 P. M., at which time Vice-President D. M. Riordan, of Arizona, took the chair.

Mr. W. W. Ashe, of North Carolina, read a "Report on the Forests in Iowa," prepared by Prof. Thos. H. McBride, of Iowa.

The recording secretary read a paper submitted by Prof. H. A. Hazen, of the Weather Bureau, on "Forests and Rainfall."

An important paper prepared by Mr. George S. Rafter, of Rochester, N. Y., on "Stream Flow in Relation to Forests," was read by title, Mr. Rafter being absent.

Invitations to hold meetings of the Association at Omaha, Neb., next summer, and at Tampa, Fla., next winter, were referred to the executive committee. Mr. Casas, of Boston, stated that the Association would be asked to meet in Boston next summer at the same time with the 50th meeting of the Society for the Advancement of Science.

Mr. Riordan then gave a short talk on Arizona. He said that the territory had all the life zones of the planet between sea level and 13,000 feet elevations. The conifers were found in a belt on the San Francisco mountains, above 700 feet elevation. Forest growth in the sense of commercial timber is there a question of altitude. The principal timber is the *Pinus ponderosa*. This exists only between 5500 and 7500 feet. Above are the spruces, and lower down the junipers. There is a body of pine timber ranging from 50 to 60 miles in width, and running 100 miles—that forest contains five or six billion feet of standing pine. There are now five sawmills, with a capacity of from five to twenty million feet per annum. Mr. Riordan mentioned the botanical wealth of the territory, the many varieties of trees, and the giant cacti, whose ribs are used for the rafters of houses.

Mr. French expressed the hope that the members present would endeavor to influence their Senators and Representatives in Washington to pass a forestry bill during the coming session. He called attention to the deficiencies in the laws for the Government forest reservations.

Mr. Riordan thought that we needed to work up more public interest. He had been ashamed at the small interest taken in forestry in Arizona until he found that Tennessee had only 3 members in this Association, and all the other Southern States not more than 24. He wished for more members like Colonel Killebrew, who could talk effectively. What we want to do is to make it a business or a political matter. We are pioneers. He contended that the next generation would not have a greater question before it. We must conduct a more systematic campaign of education. He would urge that the list of members in the South be increased. Germany has sent men over here to find out what kind of timber we like, and has begun planting trees to supply us when ours are gone. He acknowledged the necessity of stringent laws to prevent depredations, but said that in many places, as in Arizona, the community looked with suspicion on any man who advocated protecting the forests.

Colonel Killebrew said, in excuse of the Southern people, that they have been poor in land. It was necessary to denude the forests in order to get the land to cultivate. The forest was regarded as an enemy. Forty or fifty years ago, in New England, they had the same antipathy to forests. He believed that the time is now present for the Southern people to conserve. He would endeavor to influence their Senators and Representatives their timber. Mr. Riordan disclaimed any intention to cast any reflections upon the people of the South. He thought the Association should have more Southern members in the next three or four years. He also commented upon the careless manner in which the Government reservations were made. He intended to talk to Congressmen about the subject.

Mr. Haskell, of Boston, suggested that the Association had placed too much weight on saving the forests. It ought to emphasize the problem of increasing the forests by scientific treatment.

Mr. Casas thought that mere numbers in membership do not count much. Constant agitation is better. With a few

scattered throughout the States who will work effectively in presenting facts in a concrete form, it does not matter how many members you have. He advocated reiterated effort.

Mr. Whittlesey called attention to the powerful assistance that the press could give, and urged the advisability of enlisting that agency in spreading information.

Dr. Schenck then responded to a general request for a few remarks. He said we must keep apart the interest of the commonwealth and the interest of the wood owner. These two classes must be approached differently. The only chance to get any good out of the woods about here is to use them for pastures. That is right, because it is the only means for getting the most money out of the woods. That is, burn them off if you get more money out of the land. That is the way for the private owner to look at it.

But this is not in agreement with the interests of the commonwealth. That must consider the general welfare of the citizens. The legislation must be framed in such a way that the wood owner gets the most money out of his woods by using them conservatively. If he were a wood owner he would cut down his woods, but would at the same time attempt to reproduce them. Forestry can only be practical on land where timber pays better than anything else. Forests which would not net 2 or 3 per cent. on the original and current investments should be cut down. He suggested that the difficulty which Colonel Killebrew found in trying to get woodland taxes remitted or reduced could be overcome by refunding the taxes.

After a vote of thanks to the people of Nashville and our worthy host, Colonel Killebrew, and the members of the local committee, the meeting adjourned *sine die*.

The day before the meeting and the day following were occupied in seeing the Exposition. Thursday night the members of the party separated for their homeward trips.

THE FORESTS OF TENNESSEE.

By COL. J. B. KILLEBREW, Nashville, Tenn.

(Read at Nashville meeting, September, 1897.)

No problem of greater importance was ever presented to the American people than that of the preservation and reproduction of the forests of the country. The accelerating consumption of timber makes it a question of but a few years when the demand must be restricted or the supplies must be drawn from other countries than our own. At the present rate of consumption a quarter of a century will see all our grand forests denuded of their most valuable timbers. There are now more than \$500,000,000 invested practically for the destruction of our forests, and not \$50,000 invested for their preservation and reproduction. This simple statement shows the grave responsibility resting upon the present generation.

The area in forests in the State of Tennessee, though reported large, will be found upon a close investigation to be much less than is generally supposed. According to the Eleventh Census, Tennessee has 20,161,583 acres in farm lands, of which a little over a half, or 10,799,828 acres, were classed as unimproved or in woodland. The Comptroller's report for 1896 shows 25,666,151 acres in the State reported for taxation.

The superficial area in the State, taking the number of square miles as reported by the Geological Survey of the United States, is 26,912,000 acres, of which there are 192,000 acres covered by lakes and rivers, leaving as the total land surface 26,720,000 acres. The difference between the number of acres reported by the Comptroller and the entire land surface of the State is 1,053,849 acres, which is doubtless to a large extent covered by towns, highways, railroads, and underestimates made by landowners. It will be seen, then, that the difference between the acreage reported for taxation and the acreage reported by the Eleventh Census is 5,504,567 acres, which may properly be credited to the wild timbered lands and coal and iron lands not attached to farms. Adding these wild and mineral lands to the unimproved lands attached to farms, it will give 16,303,604 acres nominally

in timber or in abandoned lands, known as old fields. Of the latter I estimate there are something near 500,000 acres. These lands consist of the worn-out, hilly slopes and fields that are fenceless or abandoned for cultivation. This leaves the wooded area of the State nominally 15,803,604 acres. But it would be misleading to suppose all this area to abound in timber trees. More than one-half of it has either been entirely denuded of its large trees, as is the case around the old charcoal furnace sites, or has been culled to furnish supplies to the more than 700 sawmills in the State, or to supply railroad ties and stocks for stave, heading, and wagon factories. The best estimate, therefore, of the probable area of the virgin forests in the State will not go beyond 7,000,000 acres. There is more than twice this amount unopened to cultivation, a large part of which is covered with second-growth timber that may, if properly protected, be valuable to future generations, or by mountain ranges in large part without timber trees.

But few States in North America can show a greater variety of valuable timber trees than Tennessee. Almost every tree to be found in the United States grows in the State; and this is due partly to the great diversity of soils, partly to the great difference in elevation (which gives a great difference in climatic influences), and partly to the abundant rainfall.

I have collected 130 kinds of woods, some eight or ten of them, however, being exotics. Among the list of indigenous trees are four varieties of ash, three of birch, two of beech, two of magnolia, five of elm, two of fir, four of gum, eight of hickory, four of locust, three of mulberry, three of maple, four of poplar, six of pine, three of sycamore, fourteen of oak, three of willow, two of walnut, besides many single valuable kinds, such as red cedar, chestnut, cypress, cottonwood (true poplar), pecan, linden, spruce, dogwood, tiswood, etc.

Nearly all the western counties of Tennessee were originally covered with heavy forests, in which many species are nearly evenly distributed. The tulip tree (locally poplar), the white oak, red oak, hickory, gum, black walnut, wild cherry, basswood, ash, elm, and beech are interspersed with one another; while cypress abounds in the swamps.

Hardin County contains a larger acreage of timber than any other county in West Tennessee, amounting to over 200,000

acres; and probably the forest growth in this county contains a greater number of varieties of timber than is found in any other, for, in addition to the usual deciduous trees that abound in other counties, there is a large area covered with a growth of pine.

In the counties of Weakley, Hardeman, McNairy, Henderson, Carroll, Henry, and Benton there are between 150,000 and 200,000 acres in each attached to the farms; in Obion, Dyer, Gibson, Haywood, Tipton, Shelby, Fayette, and Madison Counties there are in each between 100,000 and 150,000 acres in timber attached to the farms. Dyer, Obion, Tipton, and Shelby, in this group, once contained the most densely wooded area in the United States, with the single exception of the State of Washington. It was not unusual to find white oak trees eight feet in diameter and poplar or tulip trees of almost equal size, rising in all their aged magnificence and grandeur to the height of 200 feet.

The counties of Crockett, Lauderdale, and Chester have each between 50,000 and 100,000 acres in woodland attached to farms. The excellence of the timber in Crockett and Lauderdale is not surpassed by that in any other counties in the State.

The large poplar log in the exhibit of the Nashville, Chattanooga and St. Louis Railway at the Centennial Exposition, measuring in diameter at the larger end 10 feet 4 inches, came from Crockett County; and while this particular log is of unusual size and length of body, there are thousands of trees in that county, consisting of white oaks, red oaks, and poplars, that will measure from four to five feet in diameter.

Coming to Middle Tennessee, we shall find the supply of good timber very scarce in the richer agricultural districts; but in a few counties, as Perry, Wayne, Hickman, and Lawrence, lying in the southwestern portion of this civil division of the State, there is a larger area of virgin forests than is probably found in any other part of the State. Wayne and Hickman Counties have each over 200,000 acres attached to the farms, besides an equal area in wild lands or lands belonging to fur-nace properties and not mentioned in the census returns. Lawrence, Fentress, Humphreys, and Stewart have each between 150,000 and 200,000 acres of woodlands attached to farms, besides many large areas of mineral lands covered with a good

forest growth. Montgomery, Dickson, Robertson, Davidson, Williamson, Maury, Giles, Sumner, Wilson, Rutherford, Lincoln, Warren, Franklin, and Jackson form another group that constitutes the fairest farming region in the South, presenting a land of freshness, beauty, and joyous fecundity, where the landscapes are grand, inspiring, and attractive, and are enlivened and adorned by swelling heights, sparkling streams, and rich verdure, luxuriant crops, tasteful farmhouses, and smiling villages—a land of high culture and a grand civilization, whose citizens, for more than a century, have, by their valor and high intelligence, inscribed their names in imperishable characters upon the keystone of American history—these counties have each yet between 100,000 and 150,000 acres in woodland, some of it still furnishing the best of poplar, cedar, ash, hickory, beech, maple, oak, and sycamore timber, with here and there some elm, linn, wild cherry, locust, and walnut. Macon, Coffee, Putnam, and Cumberland have the same area of wooded lands attached to farms as the preceding group; but they have also more than an equal area in wild lands. The timber on the wild lands of Macon, Coffee, and Putnam Counties, in this group, consists mainly of white oak, red oak, poplar, beech, gum, and hickory; while in Cumberland County pine, red oak, and chestnut predominate.

The remaining counties in Middle Tennessee, with the exception of Van Buren and Trousdale, have between 50,000 and 100,000 acres of woodland attached to the farms. Van Buren and Trousdale are both small counties, and though the woodlands attached to the farms are less than 50,000 acres in each, yet there are considerable areas of wild lands; and this is especially true of Van Buren, where the yellow pine, black gum, white oak, and red oak are the prevailing arboreal growth.

In East Tennessee, Scott County has a larger area in timber than any other county, going beyond 200,000 acres, besides a considerable quantity of wild or mineral lands. In the amount of woodlands attached to farms it stands side by side with Hardin, in West Tennessee, and with Hickman and Wayne, in Middle Tennessee.

The next group, composed of Johnson, Green, Sevier, Monroe, and Campbell, have between 150,000 and 200,000 acres each attached to farms, and possibly as much wild land not re-

ported by the census. Morgan, Roane, McMinn, Blount, Knox, Claiborne, Hawkins, Cocke, and Sullivan Counties have between 150,000 and 200,000 acres of woodlands reported in the Eleventh Census, besides an undetermined quantity of wild and mineral lands covered, for the most part, by forests.

All the remaining counties in East Tennessee have each attached to the farms between 50,000 and 100,000 acres of woodlands, with the exception of the small county of Hamblen, which has less than 50,000 acres of timbered lands.

The most valuable timber trees in East Tennessee are the poplar, pine, chestnut, and white oak. The county of Scott has a large supply of poplar and oak; Morgan, Carter, Washington, Greene, Cocke, and Sevier, of white oak, white and yellow pine, poplar, red oak, and hemlock; and Johnson, of chestnut and hemlock. There is also a large amount of good timber in Sullivan, Hawkins, Hancock, Claiborne, and Campbell, consisting of almost all the varieties of the timber trees found in the State.

The rapid increase in the consumption of timber in the State of Tennessee may be inferred from the following figures, taken from the census returns of lumber mills and sawmills for the years 1870, 1880, and 1890. In 1870 there were 702 sawmills, shingle mills, and stave mills, with an invested capital of \$1,622,741, employing on an average 2910 persons, paying in wages for the year \$573,364, and turning out products to the value of \$3,390,687. In 1880 the number of mills was 755, with an invested capital of \$2,004,503; average number of employes, 3718, who received in wages \$549,222, turning out products valued at \$3,744,905. In 1890 the number of mills was 789, with an invested capital of \$7,186,127; number of employes, 8004; wages paid, \$2,194,615; value of products, \$8,941,965. It will be seen that there was very little increase in the business between 1870 and 1880; but between 1880 and 1890, while the number of establishments increased but a little over four per cent., the capital invested increased over 258 per cent.; the number of employes, 120 per cent.; and the amount of wages paid, 300 per cent.; while the value of the products increased 139 per cent. From these comparisons two facts are deducible: First, that the capacity of the mills has increased during the past decade more than 100 per cent.; and,

second, that the wages of the employes have been increased 80 per cent.; while the value of products per capita has been increased a little less than 10 per cent.

The number of feet of logs purchased by mills for the census year in Tennessee was 2,854,674,000, and the amount obtained by the mill men in the woods was 141,206,000, at a total cost of \$4,615,269.

The amount of furniture stock obtained in the State for the census year was 6,644,000 feet, but at a cost of a little over \$16 per thousand feet, amounting to \$108,418. The sawed lumber amounted to 450,097,000 feet, at an average value of \$12.50 per thousand feet, making a gross valuation of \$5,678,762. The number of shingles made in the State was 19,537,000, valued at \$41,017; staves, 60,490,000, valued at \$589,200; heading, 8,675,783 sets, valued at \$157,507. Besides these items, there were a vast number of handles, spokes, hubs, bent work, etc.

Since 1890, the lumbering business of the State has increased with great (and, I may say, with alarming) rapidity. Estimates made from careful inquiry lead me to believe that the number of establishments now in the State are 50 per cent. greater than they ever were in its history; nor is the end yet reached, for nearly every week shows some new lumbering mill, stave mill, or shingle mill erected or planing mill established. I have no means by which to estimate with any degree of certainty the number of logs now cut or the amount of lumber now made in the entire State; nor have I been able to procure the statistics for hubs, spokes, handles, etc., for the entire State of Tennessee; but I find that the production for the year 1896, along the line of the Nashville, Chattanooga and St. Louis Railway, was as follows:

Spokes.....	6,750,000
Handles.....	594,000
Hubs.....	60,000
Rims.....	102,000
Neck yokes, singletrees, etc.....	750,000

I think that this is about three-fourths of the production of such articles in the entire State.

The number of staves made along this line for the year 1896 was 240,000,000, which is four times as many as were made in

the entire State in 1890. Most of these are made on the Northwestern Division and branches of the Nashville, Chattanooga and St. Louis Railway, where there are now fifty-seven stave factories in operation. The whole number of staves made in this region in 1873 was 1,650,000.

The value of exports of lumber and forest products from the United States for the year ending June 30, 1897, was \$39,624,800, as against the value of \$31,947,108 for the year previous, an increase of 24 per cent. The average value of board deals and plank for the month of June was \$16.13 per thousand feet, which is an increase of \$1.39 over the average value of the preceding two years, and \$2.21 over the average for the years 1896-97.

For many years Nashville was the largest hardwood market in the world; but recently both St. Louis and Chicago have gone ahead of it, and it now stands third.

The average shipments of lumber from Nashville now amount to 27,000,000 feet annually. Of this 15,000,000 feet is poplar, 7,000,000 feet oak, and 5,000,000 feet ash and other woods. About 60,000,000 feet are carried in stock in the Nashville market.

It is evident that the destruction of forests in the State of Tennessee is growing with an alarming rapidity. While the State has yet an ample supply of timber, it is every year becoming apparent that some legislation is demanded for its preservation and reproduction. What shall this legislation be?

First, there should be a severe punishment inflicted on all persons who willfully or maliciously set the woods on fire. From time immemorial it has been the custom of those living in thinly settled regions to burn off the leaves from the wooded lands in order that the wild, coarse grasses might spring up and supply pasturage for domestic animals, and especially for cattle and sheep. There is no record of damage done to the forests in Tennessee by such fires later than for the year 1880, when the census reports showed that 985,420 acres of timber were thus destroyed. Of these destructive fires nineteen per cent. came from burning off the woods in order that the early grass might come. An equal percentage of fires came from the burning of brush in clearing lands. Six per cent. were charged to railway locomotives, fourteen per cent. from hunters' camps, four-

teen per cent. from malicious persons, and one per cent. from smoking. This is a serious loss to the people of Tennessee, amounting in one year to about six per cent. of the entire wooded area of the State. No doubt the percentage is much larger than that reported, for from many of the districts in the State no returns whatever were made.

The loss of the timber does not cover the damage done to the soil by the destruction of leaves, humus, and undergrowth. The forests of the future are swept away, and even the seeds and germs of plants are destroyed. Careful inquiry as to the damaging effects of forest fires in Michigan lead me to believe that the value of the timber is scarcely one-half of the loss sustained by such fires in that State. It is a rare thing to see in any burned district other growth than dwarf birch, hemlock, scrub oaks, and other shrubs of no value whatever. Indeed, scarcely any crop will grow vigorously when planted on a burned district in Michigan; but I do not believe such fires injure the productive capacity of the soils in Tennessee, but they doubtless impair the durability of the soils.

Great damage is done to the forests by browsing animals. This damage arises from two causes: 1. The trampling of the land, which impairs the vitality of the trees and causes many of them to die. 2. Myriads of small trees, which are the embryo forests of posterity, are killed by being stripped of their leaves and barked by the browsing animals. Hogs often destroy young pines by rooting them up in order to feed upon the succulent roots. It is scarcely a question of doubt that the high-land pasturage of Tennessee, causing as it does the destruction of so much young timber, costs the State every year more than all the stock is worth that feeds upon such pasturage.

No more land, especially in the thickly settled districts of the State, should be opened for cultivation. The ax of the pioneer has done its work. The present generation should restore and build up the waste places, take steps to reproduce the timber upon all spots unfit for tillage, and carefully preserve the vigor of all forests by only cutting out the decayed timber and trees that have attained their probable full value for lumber. There should be a greater economy practiced in the use of timber. Fences in the future should be built of wire, and locust or cedar trees should be planted all along the line of such fences to serve

as posts. Coal is now so cheap that it should be used for domestic purposes in the place of wood whenever it can be had at a price not exceeding ten cents per bushel.

More than a quarter of a century ago I suggested that all old fields in the State that had been abandoned on account of their sterility and all steep slopes in the fields liable to wash should not be taxed for a period of ten years, provided the owners of such spots and old fields would plant them in timber and cultivate the same until the trees should become firmly established and reach a condition of vigorous vitality. This idea was warmly embraced by many progressive thinkers in the State; but, unfortunately, the provision in our State Constitution directing that all property shall be equally taxed, with certain named exceptions only, made it impossible for the Legislature to act upon the suggestion. Should a constitutional convention ever be called, this question of the reproduction of our forests should receive due consideration, and should be encouraged by granting exemptions from taxation of all such lands as are planted in timber and cultivated in a prescribed manner. My estimate that there are 500,000 acres of such land in the State is not excessive; and could this large, worthless acreage be made fruitful of timber for the uses of our posterity, we shall do much to awaken their gratitude and give to them a just regard for and a proper conception of our wisdom. Were these places broken up and sown in acorns or hickory nuts or planted with small locusts, the effect would in every way be salutary. The land would be reclaimed. What is now valueless would become valuable. The hideousness of the landscape would be converted into beauty and blooming attractiveness. A spot for the retention of moisture would be created, and a small tax-paying property converted into one that would contribute largely to the revenues of the State.

The natural wealth of every State depends primarily upon its timber and soils; and it should be the highest and most solemn duty of our lawmakers to look beyond the present and to enact such laws and pursue such a policy as will in the end conduce to the wealth, greatness, and glory of the State and the prosperity of its citizens; and in no way can this be more effectually done than by taking steps for the reclamation of the soil and the preservation of the timber. Had this been done fifty years ago,

Tennessee would not now be dotted all over with repulsive and haggard old fields that constitute the shame and mark the shiftlessness of her farmers. A new departure is called for in this particular, and he who shall be instrumental in restoring the lost fertility of these waste places and making them things of beauty and profit may well be numbered among the benefactors of mankind.

The press in the various parts of the State should take up this subject, discuss it in detail, encourage the enactment of such constitutional provisions as will remove present hindrances, and press the matter before the people until pride, taste, interest, ambition, the highest wisdom, and an enlightened public sentiment shall unite in building up these sterile places. Enough of such spots there are, if reclaimed, to build a railroad through every county in the State.

More is involved in this question than mere money. The very existence of the human race is imperiled by this neglect. Happiness, contentment, progress, refinement, and true civilization depend, in a measure, upon the preservation of our forests, which greatly affect climate, and the preservation of our soils, which so greatly affect production and population.

Nor should the railroads, with all their influence and accumulated wealth, fail to give encouragement in every possible way to the preservation and reproduction of our forests. For the period of eleven years the Nashville, Chattanooga and St. Louis Railway has consumed annually 370 ties on an average for each mile of main track. This includes the requirements for about 195 miles of new track in eleven years. The consumption for the State on this basis would reach 1,147,000 ties, requiring 38,232 acres annually to supply. The life of the railroad ties in Tennessee is greater than the average life of ties in the whole country for two reasons—viz., first, the ties are larger and made altogether from selected trees, and they are smoothly hewn; second, the traffic is not so heavy as the average traffic of the whole country, and ties are not subjected to such frequent use in carrying large burdens. The railroads of the country are annually consuming 90,000,000 ties. If the life of railroad ties for the entire country could be extended to the limit reached by the ties of the Nashville, Chattanooga and St. Louis Railway, which is about eight years, 67,000,000 ties only would be

required for the annual consumption of the 181,000 miles of railroads in the United States instead of 90,000,000.

The total consumption for railroad purposes in the United States, which includes ties, trestle and culvert timber, timber for cars, etc., is estimated to be 500,000,000 cubic feet, or 6,000,000,000 feet, board measure. Estimating 6000 feet of merchantable timber to the acre, which must be regarded as liberal, it will require 1,000,000 acres of timber annually to supply the needs of the present railroads in the United States.

This large consumption of timber for ties is a serious drain upon the forests of the country, requiring 40,000,000 trees, on the assumption that an average of two ties may be had from one tree. Fifteen trees to the acre suitable for making ties would be a full estimate, so that it will require the culling of 2,266,660 acres a year to supply this demand. The right of way held by the 181,000 miles of railroads of the United States, assuming the width of 100 feet, take up not less than 2,172,000 acres. If this were planted in locust trees or catalpa so as to form one row of trees on each side of the track fifty feet distant from the track, the trees being set four feet apart, it would give room to grow 477,840,000 trees, which ought to make 90,000,000 ties. The life of black or yellow locust is from seven to ten years.

With proper culture and attention, these locust trees would be large enough in fifteen years to make railway ties. This would supply an annual average of 60,000,000 ties. This is about two-thirds the number necessary to meet the present requirements of the railroads of the United States. It would be wisdom in the management of the railway lines to utilize their right of way in this manner.

It is a false patriotism to rob our posterity of their natural rights, and not to protect the timber of our State is a crime against civilization and a crime against posterity. Our present destructive methods combine the stupidity of unthinking barbarism and the cupidity or unprincipled selfishness with the wantonness of unbridled license. Forests are the breathing places of mother earth, the beautiful vestments that hide her nudity and decorate her person. Forests, indeed, play a most wonderful and important part in the economy of nature. They temper the severity of the wintry blasts; they give a grateful freshness to the summer breezes; they regulate the flow of our

rivers, and keep our springs from drying up; they shield the earth, and protect it from the deep freezes in winter; they induce a regularity in the rainfall; their verdure beautifies the land; their leaves fructify the soil; and their shade adds a genial quality to every home.

FOREST TREES AND FOREST CONDITIONS OF EASTERN AND MIDDLE TENNESSEE.

By GEORGE B. SUDWORTH, Dendrologist, U. S. Division of Forestry, Washington, D. C.

There is no other Southern state which, together with the valuable timber resources it has had, and now has, can compare with Tennessee. There is no other Southern state that comprises within its length and breadth the same widely diversified forest conditions. Glancing over its three great geographical divisions into eastern, middle and western Tennessee, we find it the middle ground where nearly all the important Northern timber trees meet with those of corresponding importance from the South. Tennessee is the land where our large eastern forest trees grow larger and our smallest trees grow largest. Plants that morphologically must be classed as trees,—though elsewhere mere bushes in size, are veritable trees in stature when found in the forest of Tennessee. The great Cottonwoods and Sycamores of the Mississippi valley lands are unsurpassed in their gigantic size, while the huge Yellow Poplars and Black Cherry of eastern Tennessee are equaled by few from any other states and surpassed by none.

But we propose to speak only of middle and eastern Tennessee, and especially of the latter division. The middle division of Tennessee, including the great Blue Grass region, is forestally less interesting than the eastern division, since it is essentially an agricultural region and may properly remain one. It contains the prize agricultural lands of the state, producing the greatest quantities and finest quality of tobacco, wheat, sweet potatoes, etc.

But originally this region was the home of the largest Red Cedar and the finest Black Walnut, Yellow Poplar and Oaks. Today, as one travels through these fertile districts, there is little to remind one of the great wealth of Red Cedar timber now practically gone from all the tillable lands. It is only the miles and miles of gray-brown two or three-hundred-year-old looking rail fences of good old Red Cedar that remind us of this former forest wealth. It must have been very common and its virtue of outlasting men and things well known. I do not know whether the old Tennesseans who split those fence rails from their abundance were guilty also of using cedar for firewood or not, but suspect that they were, as even now some of their descendants use the stumps for this purpose. It is eminently the greatest cedar region of the South.

Red Cedar is found in nearly every county of the state, but a circle of counties, including Wilson, Rutherford, Marshall, Fentress, Overton, Davidson and Pickett, comprises the region of old and new supply, from which about all the commercial Red Cedar of the state was and is derived.

Although the Red Cedar is forever gone from these fertile lands, it still remains on the small and large areas, as the case may be, of exposed limestone and otherwise barren knobs which are scattered throughout the region. These spots, from one-half to fifty or more acres in size, give one the impression that Red Cedar grows there because it cannot help it. A large amount of this cedar now left is of young growth with low-branched crowns and trunks, small enough to escape doing duty as telegraph poles, though somewhat in danger for small fence posts. Nearly every county, too, has its small bodies of prime old cedar, in most cases standing on limestone, which have escaped the axe of the pencil-wood buyer, the bucket and chest maker, and especially the hunter after piling and telegraph poles. It should be said, however, that this immunity is only temporary and due to the fact that the timber cannot be bought for one or other reason. The local buyers know every old tree for miles, and one told me he was only waiting for the death of one owner whose heirs he knew would sell as soon as they had the power. And so I believe that were it possible for buyers to lay hands upon all the sizeable cedar timber now, it would not last over five years, if that long.

The Virgin Red Cedar of middle Tennessee is several centuries old and in some cases very large. Although really large cedar is at present very rarely seen, I saw some fine sound timber, the butt log in one case squaring thirty-seven inches with an estimated age of two hundred and ninety years and averaging about three twelve-foot logs to the tree. But I noticed that the owner of these logs was careful to lock the door after we left the store-house.

Although we should never expect to see the good farming lands of middle Tennessee again clothed with bog Red Cedar and other timber, as in days gone by, the farmer forester of today has little to do but keep out fire and grazing stock from the rocky waste land on the farm to see it bristle with young Red Cedars. They refuse to grow only where there are no fissures in the exposed rock, and elsewhere often form dense forest cover under conditions too dry and barren for any other tree.

While the general impression one receives in traveling through middle Tennessee is that cedars are the dominant feature, there are, nevertheless, many characteristic broad-leaved trees, although the great abundance of this class of trees is found in the eastern division of the state. The specially fertile character of the soil in the Blue Grass region has very probably resulted through clearing in the practical disappearance of all large bodies of hardwood trees. Wherever the farms are of uniformly good land, the often almost total lack of farm woodlots is a feature that impresses the stranger. The large and small streams usually have fringes of hardwoods, which broaden out wherever the land becomes non-agricultural, that is composed of surface lime and other rock. The remnant old forest trees in rich moist bottoms are usually large and consist principally of Tulip trees, White, Red, Green, and Blue Ashes, many species of oak, White, Rock, Chestnut, Bur, Cow, Overcup, Chinquapin, Red, Yellow, and Texas Oaks, Red, Black, Sugar and Ash-leaved Maples. The White Linden or Basswood is the commercial *Tilia* of southern forests, is a large timber tree throughout middle Tennessee scattered singly or in groups of a few individuals along the streams, or here and there over the dry rocky hills.

One sees an occasional Silverleaf Maple, Black Willow, Water Locust, Box-elder, Winged and American Elm, to-

gether with the adaptive southern Hackberry (*Celtis mississippiensis*), occupying the low clayey spots. The upland wooded areas are further characterized by several distinct soil conditions, three of which are very common: poor, dry, gravelly and clayey hills and knobs with Beech, White Oak, Red Oak, occasional Texas Oak, Pignut, Mockernut, and Shagbark hickories, sometimes here and there a Red Cedar interspersed. Then, again, one meets a richer clayey loam with frequent outcroppings of shaly limestone, in places running out into large areas of exposed deeply fissured lime rock, where the characteristic forest trees are Sugar Maples, Beech, White Basswood, Red and Yellow Oaks, White and Chinquapin Oaks, Bitternut, Shagbark and Shellbark Hickories, Red Mulberry, Southern Hackberry, White and Blue Ashes, Honey Locust, Hop Hornbeam, and many smaller, unimportant species.

The extensive areas of exposed lime rock with numerous deep fissures is in spots often strangely well clad with fairly well-grown open stands of Sugar Maple, White Ash, White Oak, Chinquapin Oak and White Basswood. The Sugar Maple here shows its ready adaptation to bare rocky sites, its big roots rambling over the rocks and searching out accumulated mould in the deep fissures, illustrating the special fitness of the often-applied common name, Rock Maple. Its other companions named are seeking the large pockets and wider gaps in the rocks where time has formed and laid up some depth of soil. In still other localities, as already noted, these bare limestone glades may run into almost pure growths of Red Cedar, while in other sections these rocky areas may have only the scattered characteristic Chinquapin Oak (*Q. acuminata*) and occasional Blue Ash.

A third very interesting forest condition of middle Tennessee is found in the plain-like stretches of heavy clay and gravel or sandy soils such as may be seen in parts of Coffee and Warren counties and the Cumberland Plateau.

Although in the middle of a fine agricultural region the thin, strongly calcareous nature of the soil seems to limit its forest growth to a few oaks, and principally to the characteristic Black Jack. The region is locally well named the "Black Jack Lands." Many miles of mostly level country show noth-

ing but the heavy glossy foliage of this peculiar oak to relieve the eye. It becomes so monotonous that even a cranky lover of trees is likely to tire in his search for some other species. But the Black Jack occasionally has an associate. The adaptive Post Oak (*Q. minor*), a very few Yellow Oaks and the Spanish Oak appear in places where the soil passes from predominating clay to an admixture of gravel; and in the wet places the Winged Elm is sometimes seen. Economically, the timber of these sections amounts to but little if anything, except for firewood, as the trees are mostly small, ranging from two to twelve inches in diameter and from ten to thirty feet in height.

The soil conditions of these districts are scarcely improved by the presence of the main species, Black Jack; for, although the stand of trees is often several hundred to the acre, apparently sufficient to shade the ground, almost everywhere a heavy growth of wild grasses cover the ground, since the narrow, dense crowns of the Black Jacks nowhere form a continuous crown-cover or shade. The hot sun—for it is occasionally hot in Tennessee—quickly evaporates all soil moisture, and the open growth allows the sweeping winds to drive the falling leaves far from their legitimate purpose of forming soil-improving humus.

In passing out from a survey of this interior Red Cedar region one is apt to be struck by the fact that very few if any species of pine have been seen; especially since the Pitch, Longleaf, Shortleaf, Virginia Scrub Pine and White Pine approach the region from some quarter. I recall now the surprise felt on several occasions in suddenly coming upon small island-like clumps of Shortleaf Pine, but in most instances it was in the outlying counties to the south and east of the great cedar belt, where the soil or climatic conditions seem to be more fitted to pine growth than in the interior. If pines of any kind ever existed here in quantity, they seem to have long since disappeared, showing themselves far less adaptive to such conditions than the cosmopolitan Red Cedar in taking possession of the waste limestone lands.

Leaving the middle comparatively plain region of Tennessee for the eastern division of the state, the lover of trees finds much more of interest—more kinds and a far more diversified country. Agriculture is carried on to a more limited degree and

the natural resources of the region appear in mineral and forest wealth. From its western border of counties just beyond the eastern loop of the Tennessee River, to the backbone of the great Appalachian chain of mountains on the east, and from the southern to the northern border of the State, east Tennessee is one vast sea of hills and mountains. Old farms nestle in the broad and narrow valleys of foothills, ridges and mountains and often climb the steep sides of the mountains. Some of the most productive agricultural lands exist here, while the most varied forest growth covers the hills, ridges and mountains. In the western and middle portions of Tennessee, where the lower mountains appear, the growth of pine is a most marked feature in its abundance on the poor, dry, gravelly and rocky slopes. But, generally speaking, there are no extensive bodies of commercial pine in this region, the old growth having long since disappeared wherever within easy reach of transportation. Except in certain localities—to be mentioned later—the second-growth pine is of comparatively small size and often mingled with Red Cedar. More species of pine occur in this region of the State than in any other part, although, as distinguished from the northern White Pine (*Pinus strobus*) they are here usually lumped together under the names “Yellow Pine” or “hard pine.” The most abundant of these possibly in commercial quantities is the Shortleaf (*Pinus echinata*), which has a natural range from Maryland to Georgia and westward to eastern Texas. As is well known, this pine ranks in commercial importance next to the famous Longleaf. The adaptation of this pine to the poor, dry hills and other sloping lands of east Tennessee is truly remarkable as seen in some localities. Theories that great care and nursing are necessary to re-establish a pine forest on entirely denuded land, are easily controverted by the thousands of young Shortleaf Pines taking possession readily, and in dense stands, of old pasture and abandoned fields, and entirely without the nursing influence of broadleaved kinds. Even under the damaging influence of tramping stock and invading fire, this young growth has gradually advanced, and solid phalanxes of saplings and middle-sized polewood now form a large part of the second-growth woodlands attached to farms, together with oaks and other hardwoods. There appears, therefore, to be no more useful

and valuable concomitant in the future forestry of east Tennessee than this willingly self-propagated Shortleaf Pine. No one has ever planted it here as a forest tree, and when farmers of this region see the necessity of applying forestry to the maintenance of various timber trees, the problem will be easy for this pine.

The next most common but much less valuable of the pitch pines is the Virginia Scrub Pine (*Pinus virginiana*), which ranges from Southern New York to Georgia and westward to middle Tennessee, where it is rather rare. In the western section of east Tennessee the Virginia Pine is, however, very abundant on all poor, dry knobs and other similar soils, and often associated with the Red Cedar and Shortleaf Pine. It is a small or middle-sized tree of no importance commercially, its best use being for a poor quality of firewood. Like the Shortleaf, but to a much greater degree, the Virginia Pine is eminently a tree for barren soils, defying its worst natural enemies,—fire and grazing stock—and quickly clothing poor, sandy, gravelly and rocky wastes.

The northern Pitch Pine (*Pinus rigida*) is also abundant and prominent as one of the pines making up a large part of the coniferous growth which covers many of the mountain slopes. The Shortleaf and Virginia Pine together often occupy the foothills and basal areas to the mountains, while higher up the Pitch Pine forms conspicuously large areas, or where the soil is richer and better adapted to hardwoods, the Pitch Pine is seen only in broad, vertical, peninsula-like strips, several miles away, appearing like deep shadows on the mountain sides. The trees are usually rather small in diameter and of short boles, not often fit for timber.

A close associate of the Pitch Pine in its highest vertical distribution is the little-known Table-Mountain Pine (*Pinus pungens*), a tree growing naturally only from the Allegheny Mountains of Pennsylvania to the mountains of eastern Tennessee. It is rarely distinguished locally, and along with the Pitch Pine is commonly called "Black Pine." But its big, stout-prickled cones and two-leaved fascicles quickly distinguish it from its three-leaved, smaller-coned associate. It usually begins high up on the Rocky Mountain slopes, where the Pitch Pine ceases, and forms open stands of low-stunted trees some-

times interspersed with gnarled Chestnut Oak. The sites where these pines grow are often so bare and rocky as to scarcely support any other form of vegetation, showing a great adaptation to dry and unfavorable situations. The short, limby trunks and its usually inaccessible location have kept it unmolested from the mountain lumberman, serving the very important purpose of checking the rush of melting snow and ice.

The last of the hard-wooded pines, the Loblolly (*Pinus taeda*) forms but a small part of the pine growth of east Tennessee, occurring chiefly and in scattered stands near the southeastern border of the State. This pine has a more abundant distribution in the South Atlantic and Gulf States.

But descending now to the lower levels of the east Tennessee mountain region, the White Pine (*Pinus strobus*) found here forms an interesting feature of the forest growth. As is well known, eastern Tennessee and western North Carolina form the southern limit in the distribution of this northern pine.

Aside from professional lumbermen of the State, few who travel through eastern Tennessee ever suspect that the northern White Pine exists in commercial quantities among those forest-clad mountains. But there are in some parts hundreds, and in other parts thousands of acres of standing White Pine which would yield from ten to fifty, and in one locality even the astonishingly large figure of one hundred thousand feet and more per acre. The bulk of this pine lies in the counties forming the northern half of east Tennessee, but extends in a more or less scattered growth clear down to the southeastern corner of the State. A great deal of the best timber has been culled years ago by portable sawmills; considerable quantities are being cut now at several points, but there still remains some of the finest White Pine standing to be seen anywhere. Much of this pine is already old, in some localities has ceased to grow, and on one or two tracts I saw the best timber dying. The peculiar soil conditions under which White Pine grows in Tennessee points very strongly to an age limit of from 150 to about 200 years of profitable growth. Approaching this latter limit there are general signs of ceasing growth and final death, in no case due to natural enemies or accidental injuries. I recall now one tract of White Pine in Johnson County where the timber stands in a broad alluvial valley of level and rolling land,

with thousands of big pines at their age limit dead or dying. This slow but sure destruction is all the more to be lamented since this timber is of the finest quality and will give an acre cut not excelled in any other State. The northern capitalists who are holding this valuable timber doubtless believe that added age will give greater value. But it should have been cut twenty-five years ago.

Compared with northern pine lands, the precise forest conditions under which White Pine grows in these mountains are interesting, as indicating the great adaptability of the species to varied soil and moisture conditions. The bulk of Tennessee White Pine occurs alike in the narrow valleys and on the long, sharp, steep mountain-like ridges. The vales and coves are all well watered by innumerable small streams, and the soil is rich, clayey loam, while the ridges have a dry, rather thin gravelly or clayey loam soil, with underlying slaty shale, in some cases entirely exposed. In rarer instances this pine occurs with deep, rich sandy loam soils of broad mountain valleys, in a few cases sharing with the Black Spruce the almost saturated mucky land bordering the cold spring streams.

The regeneration of White Pine in Tennessee is a most important feature of the future forestry of this section. It grows here as rapidly for its allotted time as elsewhere, and should certainly serve as a concomitant in the forests to come. The utilization of the present natural seeding capacity of old standing White Pine is of the greatest value if a continuance of this timber is expected. Most of the pine occurs as dominant growth, with a dense undergrowth of oaks, chestnut, hickories, maples, ashes, and many smaller kinds, beneath which today there are millions of pine seedlings from one to ten years old. Better nurse conditions could not be wished for, and if left to themselves the young pines would again form a heavy stand of pine. But at this critical point the Tennessee lumbermen are cutting over the White Pine lands as fast as they can, in some instances taking everything down to eight inches. Such rapid and complete exploitation is very, and usually almost totally, destructive to the tender undergrowth of pine, as no care is taken to preserve it. After the timber is taken off, these cut-over lands look much as if a South Dakota cyclone had visited them. Innumerable bare lanes are cut in "snaking" out the

logs and with the quantities of dead brush strewn everywhere, the trampling of grazing cattle after the incoming grass with the inevitable torch of the careless hunter will forever sweep away the last chance of reproducing White Pine by natural seeding.

In the moister sites the White Pine is almost always accompanied with large quantities of Hemlock, which is another of the valuable conifers of east Tennessee. In those portions of the mountains near the eastern State line, especially in the lower-lying rich "cove" lands in sections where White Pine is not to be found, a heavy stand of Hemlock often covers large areas and forms the dominant growth. Here the timber is very large.

The mention of three other species completes the list of conifers found in the State—eleven in all. Nearing the high peaks of this great mountain region, large bodies of Black Spruce are found in the densest of pure growth, sometimes associated in limited numbers with the southern Alpine Fir (*Abies fraseri*), and very often extending down the mountain sides among the hardwoods. A thick mat of soft moss covers the underlying, broken and fissured rocks where these spruces grow, the timber standing as close as possible. The timber is of commercial value, both by its abundance and size, and has never been touched; but with the present absence of railroad connections lumbering at 4000 to 6000 feet elevation requires more capital and enterprise than lower down among the White Pines. The Black Spruce occurs mostly on upper peaks of the mountains and all along the eastern border of the State, but in a few localities may be found in small quantities, scattered among lowland hardwoods along streams and in wet, mucky lands of the low mountain valleys. In still rarer instances trees are known to exist in limited numbers in western counties of east Tennessee; in one case as far out as Grundy County.

The conspicuous, but less valuable, Fraser Balsam of the same relative habitat, is often found clothing the high peaks with its dark evergreen growth. It forms very dense stands on the summits, but is occasionally found lower down mingled with hardwoods and spruces. For the most part this fir occurs only in the counties lying along the great divide, and extending over into North Carolina. The light, soft wood of the Fraser

Balsam is commercially of little or no importance, being very like that of its congener, the northern Balsam Fir (*Abies balsamea*). The Tennessee mountaineers gather the thick resin from the long, narrow "blisters" in the bark of this tree by puncturing the blisters and squeezing the resin into a rude gourd bottle. Its well-known medicinal properties give it a ready sale and furnish a small revenue to the mountaineer. But our city boys would consider the money too hard-earned, for it takes many a blister to make an ounce and many a mile's steep, hard climbing before the trees are reached.

The spruce and fir of this region do not occur in continuous growth throughout the mountains, even along the high points of the divide, but very irregularly on isolated peaks and slopes, interrupted by laurel-covered "balds" or those timbered with hardwoods. In many localities the underlying, broken rock of these mountain tops and sides has a deep soil humus supporting a fine growth of hardwoods. The cold, pure air of those heights is very similar to a northern climate, and as a matter of fact many of the northern trees and shrubs are found here. The Mountain Maple (*Acer spicatum*) and Moose Maple (*Acer pennsylvanicum*), the Mountain Ash (*Pyrus americana*) and Holly (*Ilex monticola*) appear here in larger size than in the New England States and the Adirondack Mountains. The Sweet Birch (*Betula lenta*) and Yellow Birch (*Betula lutea*) grow to enormous size here, and the rose-flowered Rhododendron blooms in the cool, misty shade, 6000 feet above the hot plains below. Somewhat stunted in stature, even the Chestnut, Red and White Oak, Black Cherry, Sugar Maple, ascend and cover the small, rich plateaus and ridges.

Lower down, the broad mountain slopes and deep, gorge-like "coves" have a forest cover of truly virgin character. In some of the eastern border counties, where railways have yet to come, the silence of those sombre forest depths is scarcely ever broken by the sound of the woodman's axe. Primeval forests of centuries guard the cold, crystal streams that flow on throughout the year. Bears and deer slake their thirst from the clear bubbling pools of these streams, and somewhere on their hidden, winding course the much-hunted moonshiner brings life into the "mountain dew." Huge Tulip trees ("Poplars"), with ages numbered by centuries, crowd the deep covers and rich moun-

tain sides with their gigantic forms. Big Black Cherries stare at you from lofty heights. The Sugar Maple, which we expect to find in perfection only in a northern forest, is represented here in great numbers and in the finest development; so, too, is the familiar Beech. The little-known Yellow Buckeye is nowhere else surpassed in its great height and diameter growth. But the one timber tree which is worth an arduous journey to see in its greatest perfection is the almost unknown Tiswood, the Snow-drop or Silver-bell tree so well known in cultivation, the *Halesia tetraptera* of older botanists; but the modern upheaval in plant names has given this tree a still larger name—*Mohrodendron carolinum*, named after our most excellent botanist of the South and fellow-member, the well-known Dr. Charles Mohr, of Mobile. Its natural range is from the Virginias to the Gulf, where it is mostly a shrub or small tree, but rises to commercial importance in the rich mountain forests of east Tennessee. Here its common dimensions are from 60 to 100 feet in height, with a diameter of one to four feet. Its dense, heavy, mahogany-like wood is practically unknown to commerce, but must prove to be a valuable cabinet wood.

The Cucumber Magnolia, a rival of the Tulip-tree in the appearance and excellence of its timber, occurs plentifully and of large size in these forests, together with the much-valued White Ash. It is interesting at this day and date to see White Ash trees three to five feet in diameter with sixty feet of clear trunk. You look at the rough bark of some other tall, straight trees and are surprised to find they are Yellow Locusts (*Robinia pseudacacia*); they are so much larger and have taller, straighter stems than elsewhere that you do not at first recognize the common locust of fence-corners. Here, too, the southern White Basswood grows to fine dimensions, scattered in small and large groups throughout the region. It is one of those useful trees that supply the present demand for excelsior, carriage and furniture wood, and should occur in dense, pure growth, but has an aggravating habit of growing only in groups. The abundance of big chestnut timber in this region makes the large chestnut of the coast region look small. You lament the fact that they grow old and die in a single century, instead of growing on for future generations, like the huge Red and White Oaks mingled with them. Occasionally you meet a big

Butternut and Walnut, but they appear not to be so much at home here in the mountains as in the middle section of the State. The Hickories, also, are comparatively rare trees in those deep mountain forests, finding more congenial soil farther westward. I saw only a few Pignuts and Shag-barks.

In so rapid a survey of the forest flora of these two interesting sections of Tennessee, I have been able hardly to speak of any but the more important commercial trees. There are many others of rare occurrence or of smaller size which make up a large part of the forest cover, but are not of commercial value. The hawthorns, cherries, plums, crab-apples, dogwoods, viburnums, aralia, magnolias, gums, asimina, hollies, ptelea, ailanthus, buckeyes, sumacs, gymnocladus, cladrastis, locusts, witch hazel, sweet gum, vaccinium, kalmia, rhododendron, bumelia, diospyros, catalpa, sassafras, sycamore, ironwood, hornbeam, birches, alders, willows, populus, and thujas are all represented in Tennessee, a large number of species swelling the total number of trees found in the middle and eastern sections of the State to 135 species.

FOREST FINANCE.

By DR. C. A. SCHENCK.

[Read at Asheville, N. C., September 17, 1897.]

Many people are still of the opinion that tree planting is an essential feature of forestry. This opinion is utterly erroneous. From a silvicultural standpoint, it is always better, and from a financial standpoint, it is in the large majority of cases better, to raise trees from self-sown seed; that is, seed falling down from mature trees standing on or near the area on which a tree crop is intended to be raised.

Why this method of raising trees is not known in the United States yet, is easily understood. It requires patience and skill, acquired during years of practical experience. Practical expe-

rience, unfortunately, cannot be gained in the United States. The requirements of tree life, especially of germination and protection in early youth, are not understood. The history of scarcely any natural tree growth is on record.

Raising a tree crop by planting trees is, of course, much simpler than raising it from self-sown seed, but it seems so expensive in this country that, generally speaking, the forester should not resort to it with a view of making the venture remunerative. However, on abandoned clearings, a crop of trees may be raised by planting, and it is, perhaps, worth while to inquire under what conditions the venture will pay.

The examination must be based on calculations with compound interest, exemplified by data taken from practical forestry.

A plantation of Spruce, made at an expense of fifteen dollars per acre, on abandoned farm lands or cleared woodland, will contain, when sixty years old, about 45,000 feet, board measure, per acre. With three and a half per cent. compound interest, the fifteen dollars per acre will have augmented, in sixty years, to \$118.20.

Under "expenses," I have neglected the taxes on real estate, amounting to, say, three cents per acre per annum, which would add up in sixty years to \$5.89 per acre. I have also neglected the interest on the value of the land, vast areas of which can certainly be had at \$4.00 per acre. The interest on this—fourteen cents per acre per annum—would add up to \$27.51 in sixty years.

Besides, in most cases, and wherever planting is done on a large scale, the employment of a watchman or ranger will be necessary, who draws a salary of, say, \$600.00 a year. Ten thousand acres is a good-sized range, and thus the expense for watching per acre per annum will be about six cents, and will amount in sixty years to \$11.79.

These items, taken together with the accumulated cost of planting (\$15.00 per acre), add up to \$163.39.

The question now arises whether the 45,000 feet spruce stumpage, grown in a plantation sixty years old, is likely to yield \$163.39 altogether, or \$3.63 per 1000 feet.

I feel sure that this will be the case wherever the forests raised are not out of reach.

The figures giving the expected output after sixty years are computed from yield tables for German Spruce, the natural rate of growth of which is, without a doubt, the same as of the American Spruce. The cost of planting (\$15.00) is a figure arrived at by experimental planting on the Biltmore estate. Three thousand plants per acre, two years old, can be raised at \$5.00. The cost of planting in plow furrows is found to be \$8.00 per acre; \$2.00 is spent for miscellaneous expenses, such as tools and supervision. Of these three thousand plants, about five hundred will attain an age of forty years, and about three hundred an age of sixty years; but almost all of them will be fit for lumber. Having grown up in close stand, they will have cleared one another from side branches.

Thus, wherever spruce has a stumpage value of \$3.50 or more per thousand feet, board measure, spruce should be planted on a large scale, and the plantation will yield $3\frac{1}{2}$ per cent. annual interest or more.

Another example in regard to the financial prospect of planting White Pine:

Visiting, under the guidance of Sir D. Brandis, some interesting forest districts in Germany, we struck, among others, a White Pine plantation in the forests belonging to the Town of Frankfort-on-the-Main, now in the Kingdom of Prussia, which plantation was made in 1851, with plants when four years old put in lines eleven feet apart. A valuation survey of the plantation furnished the following figures:

Number of trees growing healthily per acre...	244
Average diameter four feet above ground....	10 in.
Diameter of the sixty largest stems.....	13 in.
Average height of trees.....	64 ft.
Volume of trees up to 3'' below crown per acre	6773 cub. ft.

These figures show the growth of forty years, as the survey was made in 1891. According to Pinchot's pamphlet on White Pine (pages 80 and 81), with trees of the above size and age, 6773 cubic feet are equal to about 13,500 feet. board measure. Now, if the original cost of planting was \$12.00, it had increased to \$47.50 in those forty years, figuring at $3\frac{1}{2}$ per cent., compound interest, and the taxes, interest on value of land and cost of supervision, estimated as before, have amounted to \$19.44.

It is evident that the plantation has paid, if the stumpage is worth now as much as the original cost plus interest, plus taxes, plus supervision, namely \$66.94 per acre, or \$4.96 per 1000 feet, board measure.

Of course, the stumpage per 1000 feet depends on quality and hauling distance. The best figures as to the value of White Pine stumpage available are those compiled by Mr. B. E. Fernow, on page 307 of the "Report of the Chief of the Division of Forestry," proceedings 1892. According to these figures, stumpage was worth in 1887 (and probably is still worth in 1897) \$4.50 to \$6.50 per 1000 feet, board measure. In other words, a plantation made at an expense of \$12.00 per acre, growing as well or as badly as the Franfort plantation, is worth \$60.75 to \$87.75 at the age of forty years, which means that tree growth of the above description is more likely to pay more than $3\frac{1}{2}$ per cent. annual interest on the capital invested than less than $3\frac{1}{2}$ per cent.

It is easy enough to increase the number of examples by which it can be shown, as surely as figures can show, that planting trees under favorable conditions is certain to pay. It pays, where the aggregate expenses for plants, planting, supervision, interest on real estate, taxes and protection, accumulated with compound interest, may be expected to be less than the expected yield or stumpage.

Why, then, any European will ask, does not American capital stream into forestry undertakings, wherever favorable conditions are given? Why do Americans not believe in remunerative forest growth, as Europeans have for the last one hundred and twenty years?

One reason is that many Americans will think the timber supply to be inexhaustible, so that the tree crop, when mature, is not sure of finding a ready market; another reason is that the interest derived from such ventures is small, say 3 to 5 per cent., and that capital and interest are constantly endangered by fire; a third reason lies in the fact that a plantation for decades of years to come absorbs taxes and does not create any cash revenue, accumulating the interest on the original capital stock.

It is scarcely worth while to touch the first point—the inexhaustibility of the supply. The report of the forestry commissions and fire wardens of the several States, and the bulletins

of the Department of Agriculture, do not admit of any doubt that the time is near, and that many of the present generation will see it, when the eastern virgin forest will be a thing of the past, and will have left no second growth in its place sufficient to meet current demands.*

The freight charges on Western timber, on the other hand, are and will be so heavy that the market price of lumber grown in the East will scarcely be influenced by supplies from the West more than by possible imports from Sweden and Norway.

The next objection to financial forestry lies in the fact that it is not likely to pay more than 3 per cent. interest on the capital invested. Forestry certainly does not offer any chance for speculation or for sudden gains. On the other hand, one must admit that no investment is as safe as money invested in real estate. There may be a chance of losing interest, but there is little chance of losing the entire capital.

Comparing the revenue from forest plantations with the revenue from other investments, it must be remembered that the very safest bonds do not pay fully 3 per cent. Investing \$100,000 in such bonds, you or your heirs and assigns, after the lapse of some score of years, will be paid back \$100,000, but the purchasing power or the productiveness of the \$100,000 will then be considerably less, owing to iron laws of political economy or civilization. A man who owns now \$100,000 worth of bonds, and does not save part of the interest in the future to increase his capital, will become poorer in the course of time, unless he has other resources. The average decrease of the purchasing power of gold has been found to be such that it is necessary for a man to save over one quarter of the annual revenue derived from the bonds and to add them to the capital, in order to remain as wealthy at the end of the time for which the loan was made or the bonds were purchased, as he was at the beginning of it.

*Letter from the Secretary to the President of the Senate dated April 15, 1897, states that the growing stock of coniferous trees consists of:

100	billion	feet	in	Northern	States.
300	"	"	"	Southern	States.
1000	"	"	"	Western	States.
75	"	"	"	Canada.	

The annual consumption is estimated to be 20 billion feet.

The value of real estate, in our case of woodlands, on the other hand, cannot possibly lessen, as long as men depend on and live on the productiveness of the ground. Whatever we use—food, clothing, water, coal, furniture, houses—is directly or indirectly a product of the lifeless ground. For this reason the value of the ground cannot decrease as long as the amount of the products required from it or the number of people living on it does not diminish. Therefore, there is no need to save one quarter or more of the revenue derived from real estate in order to remain as wealthy as before. Consequently, 4 per cent. earned from real estate is equal to a revenue of 5 per cent. from bonds or loans.

If we further believe that real estate increases in value just as rapidly as the population increases in numbers (in the United States $1\frac{1}{2}$ per cent. per annum), we must necessarily admit that real estate bears another $1\frac{1}{2}$ per cent. of interest, which is not paid out cash, but is added to the original capital. Hence, it will appear that $2\frac{1}{2}$ per cent. annual interest from real estate corresponds with 4 per cent. actual interest from real estate, and with 5 per cent. interest derived from bonds or loans.

For these reasons, it seems to me, that capital invested in forest plantations and paying, say, 3 per cent. annual interest is invested in a remunerative way, far more remunerative than bonds yielding 3 per cent.

The question, of course, is whether both investments—forest plantations and Government bonds—are equally safe. And here the objection will be made that capital invested in forests, especially in coniferous woods, is constantly endangered by fire, and, therefore, Government bonds appear to be safer. The answer to this objection is that it is easy to prevent fires if measures are taken from the start of forest growth on. For instance, if "safety belts" left unplanted separate the plantations; if broad-leaved and coniferous woods are properly mixed; if there is some system of forest guards, by which the rangers act also as foremen with day laborers, controllers of contractors and gardeners in the forest nurseries. In Europe, where the large majority of woods are raised under a forester's care, destructive forest fires are practically unknown. In this country, it has been proved repeatedly that forest fires in virgin forest—where, of course, it is much more difficult to check them than

in forest plantations—can be prevented if the proper measures are taken.

In the mountain forests owned by George W. Vanderbilt in Western North Carolina, where forest fires set out by farmers for pasturing purposes were an annual occurrence and seemed to be unavoidable, because they were thought to be essential to the welfare of the mountain population, a small staff of rangers or gate-keepers has succeeded in preventing or stopping fires almost entirely. During the dry days of three months of the year—April, May and November—when danger of fire is imminent, the rangers have the assistance of a few helpers. Besides, we concentrate day work and contract work as much as possible upon this season, with a view of having larger crews of workmen at hand in case of fire, instead of spreading work over all the months of the year uniformly.

The danger from fire threatening tree growth, however great it be, in unprotected virgin forests, can be made nil in forest plantations. Financially, forest fires threaten the revenue from tree growth only in so far as they necessitate the permanent or temporary employment of a staff of watchmen.

On the other hand, we all know that the welfare and therefore the credit of nations, states and governments is subject to change, and in consequence their outstanding obligations fluctuate in value. None are absolutely safe; the insolvency of, say, the German or French Governments is certainly more within the scope of possibility than the destruction by fire of the forests in Germany or France.

I now come to consider the third objection to forestry ventures: the fact that forest plantations, during the first decades of their existence, absorb taxes and do not pay out any cash revenue, accumulating the interest on the capital stock in such a way that it cannot be separated. The annual growth of a tree is a layer of wood surrounding the tree. As it is impossible to peel this annual layer off, the annual growth of the tree can not be converted into money every year. It is added to the original, not allowing of separation.

Compared with a crop of wheat or corn, the tree crop suffers under the disadvantage that revenue cannot be derived from it by harvesting it annually.

On the other hand, the forester is not compelled to harvest his crop during periods of panics and low prices, as the farmer

is. He simply allows it to grow, until more favorable conditions of the lumber market return.

Financially, the following example will show what the annual revenue of interest accumulated by forest plantations is.

Suppose a plantation is made at an expense of \$17.90 and is expected to have a net value freed from all expenses for protection, trees, etc., of \$100 after another fifty years, thus growing at $3\frac{1}{2}$ per cent. compound interest. The plantation is worth:

Now.....	\$17 90	current revenue	\$ 00
Next year.....	18 53	" "	63
Two years from now.....	19 18	" "	65
Three years from now.....	19 85	" "	67
Four years from now.....	20 55	" "	70
Ten years from now.....	25 25	" "	85
Twenty years from now.....	35 62	" "	1 20
Thirty years from now.....	50 25	" "	1 70
Forty years from now.....	70 89	" "	2 40
Forty-five years from now.....	84 20	" "	2 84
Forty-six years from now.....	87 14	" "	2 94
Forty-seven years from now...	90 19	" "	3 05
Forty-eight years from now.....	93 35	" "	3 16
Forty-nine years from now.....	96 62	" "	3 27
Fifty years from now.....	100 00	" "	3 38

It appears that the plantation has paid during the first year of its life only 63 cents, and during its fiftieth year \$3.38. Thus the interest paid by it seems to differ ; however, a closer examination will show that it was in all cases uniformly $3\frac{1}{2}$ per cent. Each year the revenue is added to the capital, and hence the revenue of the next year is a little higher.

Two inferences may be derived from the foregoing: First, that only such people should invest money in forest plantations who can get along without cash returns from the investment for a number of years; second, that there is nothing in the world yielding compound interest so regularly and surely as forestry, and, therefore, forestry is the best savings bank. However great a drawback to forestry the first fact is, the second fact largely compensates for it. Abroad, it has preserved hundreds of noble families. The merchants of Nurnberg and Augsburg in the Sixteenth Century were richer than Charles V. Their wealth disappeared, their families were impoverished and their name is gone. On the other hand, many of the Chevaliers at

the Court of Charles V., and his successors, owning a so-called castle and a few thousand acres of woodland—then no more valuable than American forests are now, have succeeded in maintaining the standing of their families by means of their for-est property.

“There is nothing new under the sun.” Up to, say, 1700 the German mountain forests in the Black Forest, the Spessart, the Vogelsberg, the Harz, etc., were valueless as regards their timber. A square mile of forest land was purchased at a price less than the present value of one of the few oaks then started. The woods served as hunting grounds for the nobility and as pasture grounds for the peasantry. Their tree growth had no value, as was once the case in most forest regions of the United States and is still the case in some of them. They had, as we now have, abundance of fuel and plenty of timber. Often the only method of deriving revenue from the woods is in feeding cattle, sheep and hogs. The woods lie unprotected by the owner, because protection does not show an immediate revenue, and unprotected by the Government, because Government does not realize their immense influence on the welfare of the commonwealth.

In this country practically all forest lands are owned by private individuals.* This fact has a double consequence. First, that forestry matters must be looked at from a mere business standpoint. *American forestry must be money-making forestry.* Second, that if the several commonwealths have a real interest in the maintenance of the private forests within their respective precincts, then forestry must be rendered remunerative to the owner by the commonwealth. To enforce proper management of private forests by stringent laws, as is done in France, Austria, Switzerland and Germany, is and will be impossible in the home country of individual freedom. *American forestry must be free forestry.* But there will be no private forestry whatever if Government does not provide for the only conditions under which private forestry can pay—fire protection and tax reduction.

*26.5 per cent. of the area of the United States are classed as woodlands. Of these, about one-sixth is still left with the Federal Government; one-third is owned by farmers and the remaining one-half is in the hands of speculators, lumbermen, mining concerns, railroads, etc.

In fact, why should the owner of woodlands pay taxes? Taxes on property are paid all the world over as compensation for protection of property. The commonwealth, however, although not protecting woodlands at all, imposes heavy taxes on them amounting to about five-eighths of a cent from the dollar in Western North Carolina. Such tax legislation is evidently unjust; but it is more than that; it is unwise, because it prevents the development of economic forestry.

We all know that these ideas have led in a few States to tax reduction on woodlands and to the organization of a protective staff of officers. The wisdom of such action cannot be praised highly enough. It is the outcome of the conviction that *American forestry*, if there shall be any, *must be put on remunerative basis by the commonwealth.*

FORESTS AND RAINFALL.

By H. A. HAZEN, U. S. Weather Bureau.

[Read at Nashville meeting, September, 1897.]

Can it be possible that the cutting away of forests affects the amount of precipitation in any locality? To many, no doubt, this question will seem easy of answer, but we find the results of study by no means reassuring, and recent investigations have led to almost diametrically opposite conclusions, depending somewhat, at least, upon the feeling of the writer. When we reflect that our rain storms are of very wide extent, oftentimes over 1000 miles in diameter, and may take their origin and bring their moisture from distances of a thousand miles or more, the thought that man may change their action or modify it in any manner, by his puny efforts, seems ridiculous in the extreme.

It has been well established that forests have a most important bearing upon the conservation of rainfall; that the forest floor permits a seepage of water to the source of springs, and

thus maintains their steady flow; that they hold back the precipitation that falls, especially in the form of snow, thus preventing or ameliorating dangerous freshets. There is not the slightest doubt of their great importance in the welfare of man, but all these facts do not affect the question of their influence upon precipitation. The following paper is prepared from the standpoint of a meteorologist, and is an attempt to present facts. Formerly the historical argument was a favorite one. I quote one of these: "It is a familiar fact that there are many regions in Asia and Southern Europe, once exceedingly fertile and densely populated, that are now utterly sterile and desolate. The country bordering on the Euphrates and portions of Turkey, Greece, Egypt, Italy and Spain, are now incapable of cultivation from the lack of rain, due to deforestation. The most fertile of all the provinces in Bucharia was that of Soga, said Malte Brun in 1826: "For eight days we may travel and not be out of one delicious garden." In 1876 another writer says of this same region: "Within thirty years, this was one of the most fertile spots of Central Asia, a country which, when well wooded and watered, was a terrestrial paradise. But within the last twenty-five years a mania of clearing has seized upon the people, and all the great forests have been cut away and the little that remained was ravaged by fire during a civil war. The consequences followed quickly and this country has been transformed into a kind of arid desert. The water courses are dried up and the irrigating canals are empty." It has also been said that in the older settled portions of New England and the Middle States there are arid hills and wornout fields, due to the falling off of precipitation from the cutting away of the forest growth. Such quotations and statements might be made to fill a large volume. Without more precise data as to rainfall it would be hazardous to conclude that we have here a case of cause and effect. It is certain that the fertility of these regions in ancient times was due to stupendous irrigation plants, and when these were neglected through wars and other untoward circumstances, the fertility necessarily ceased. It is certain that there are ruins of enormous irrigating ditches and canals in Babylonia, where history indicates there was once a teeming population and great fertility, but where now only a sandy desert greets the eye.

Some have said that where our densest forests are found there we have the greatest precipitation. There is no way whereby we can see that such forests would have started unless favored by rainfall, so that the presence of the forest rather indicates the earlier occurrence of practically the same rainfall as at present. Meteorologists are agreed that there has been practically no change in the climate of the world since the earliest mention of such climates. Plants found in mummy cases in Egypt that were plucked thousands of years ago show the same size as those now found in that land. The "early and the latter rain" are experienced in Palestine today just as they were 4000 years ago. Jordan "overflows all its banks" today in February precisely as it did in Joshua's day. When we come down to recent times and to the records of rainfall measured in New England for more than 100 years, or at least before and since the forests were cut, we find a constancy in the rainfall which shows its entire independence of man's efforts. Right here it should be noted that totally barren lands of any extent—in New England, for example—are to be found only in imagination. Even where the forest has been cut away, mercilessly there springs up a growth of sprouts which covers the ground and answers almost the same purpose in causing rainfall (if there is any effect of that kind) as the forest. Even where land is entirely cleared of a forest we have the green pasture and still heavier crops, which leave the ground anything but a sandy waste.

But the strongest argument adduced in the past to show the influence of forest on rainfall has existed in a comparison between raingauge measures in the forest and the open field. Such records have been made for more than thirty years in France and Germany, and surely we must have here, if anywhere, a sufficient proof of a forest influence.

Admitting that we have perfect instruments and careful observers, there still remains a most serious doubt as to the immediate environment of each gauge and as to the possibility of a direct comparison. It is probable that no two gauges 2000 feet apart can be placed so as to catch the same amount of rain, though to all appearances the exposure is faultless in each case. This is plainly seen on the roof of a building. For example, before the office of the Weather Bureau was removed to its pres-

ent location in Washington, eighteen rain gauges were placed on the roof and one upon the sod not 500 feet away. There was only one of the gauges that gave the same rainfall in all storms as the one on the sod. Some of the others gave more in some storms and some less, but all of them in the total rainfall of eight months gave less than the one which compared exactly with the sod gauge. In an early publication of rainfall records in this country (not by the Weather Bureau, however), two stations are given in Illinois not more than three miles apart, but yet differing by twenty-three inches in the total annual precipitation for several years. I have no doubt that in the latter instance one or both gauges were badly exposed; but enough has been said to show the extreme caution needed in studying such records and the absolute necessity that exists in obtaining a comparison between gauges that are not affected harmfully by their surroundings.

One of the best of all researches in this line has been conducted at Nancy, in France. Within a distance of five or six miles there have been four stations established. At Nancy, in the open, and at Bellefontaine, in the forest, and 500 feet higher vertically at Amance (open), and Cinq-Tranchees (forest). The latter stations are in a more hilly region, and cannot be compared together as can the former. At the lower stations we have comparative observations for twenty years. I have summed these in three groups, containing eight, eight and nine years in each group. First group, Nancy, had 31.16 inches, while Bellefontaine (forest) had 32.46 inches. Second group, 33.39 and 34.07. Third group, 30.05 and 29.89. We see that while the first eight years showed a very slight excess in the forest rainfall over that in the open field, in the last nine years (including 1894, last published), the open station showed a little more rain than the forest station. These observations were made with particular care for the purpose of exactly determining the influence, and may be relied on if the environments of the gauges were comparable. At Amance (open), and Cinq-Tranchees (forest), the observations have not been quite so regular, though we have twenty-five full years of records at these two stations, but not the same years as at the other stations. Amance shows 26.70 inches and Cinq-Tranchees (forest) 33.39 inches, or an apparent preponderance of 6.7 inches a

year in the forest. This would make more than 25 per cent. more in the forest than in the open. It should be borne in mind, however, that these two last stations are on an eminence, and are strictly comparable, and this result cannot vitiate that at the two other stations, which shows no effect.

In Germany we have a rather remarkable record of a slightly different character. Lintzel is a station on the Luneburg heath, and began to be planted with trees in 1877, at the rate of 1000 to 1500 acres a year, and in a few years over 8000 acres were covered. In the midst of this forest is the meteorologic station in an open field of some seventy-five acres. Before planting the forest 97 per cent. of the surface was field, meadow or heath, and afterward 80 per cent. was forest, and 20 per cent. was roads, open field and heath. Around this station, pretty evenly distributed and within fifty miles, there are thirteen rainfall stations which have been carefully established and presumably are comparable with the Lintzel station in the midst of the growing forest. There is no means of knowing whether any of these stations have been changed or not, but for our purpose we may consider the material homogenous and treat it accordingly. Records from 1882 to 1896 (fifteen years) are available. Charts were prepared for each year showing the ratio between the Lintzel record and that at each station of the thirteen. There is no space for these charts, but in place of them I give here the mean of all the thirteen stations for each year:

Year 1882, 81; 1883, 83; 1884, 101; 1885, 103; 1886, 82; 1887, 98; 1888, 93; 1889, 122; 1890, 97; 1891, 100; 1892, 90; 1893, 96; 1894, 142; 1895, 128; 1896, 136.

These figures are extremely significant and may be further elucidated, as follows: The smallest ratios show a less rainfall at Lintzel, or, these figures are the percentage of rainfall at Lintzel, as compared with surrounding stations. It is impossible to determine whether these trees have reached the culmination of their effect or not. In 1896, most of them would be 17 years old, and the ground would probably be fairly covered. It is a great pity that the environment was changed or some accident happened at Lintzel so as to vitiate the three last years (an inquiry was sent to Germany regarding the error, but no response has yet been received). The record does not seem to show any appreciable effect upon the precipitation; in 1884 the ratio

was 101, while in 1893, nine years later, it was 96. It is probable that no definite and unassailable result can ever be obtained either by the method adopted in France or this later one in Germany. The rainfall is so variable within a distance of even a mile or two, and it is so difficult, if not impossible, to obtain similar environments at all the stations, that no decisive result can be obtained. It will be seen readily that the multiplication of stations will do no good, and, above all, that the observation of rainfall under trees in a forest is absolutely useless for any such discussion or study as this.

It seems probable that if two or three lines of stations could be established a mile or two apart on four sides of an enormous forest, each line to have a dozen stations or so, about 3000 feet apart, four of the stations to be outside of the forest and the others each in a large, cleared space of at least two acres extent in the forest, something decisive might be obtained. It should be noted, however, that from the evidence already accumulated there would be very little to be gained by a further study of the question. It is certain that the effect, if there be one, is almost inappreciable. The favoring conditions over the forest are balanced by those not favoring, and the integrated effect is practically the same in the two cases.

Prof. F. H. Blanford, of India, determined from a most careful series of records, from which all known errors had been eliminated, that the forest had a tendency to give 2 per cent. more rain than contiguous open fields. That is, if an open place had 50 inches of rain in a year, a near-by forest would have only 51 inches, which is practically inappreciable.

It would be an interesting study to select all these cases, in experiments in forest and near-by fields, in which the wind was blowing either from the forest to the field, or *vice versa*. It is evident that if there is any effect on rainfall by the forest, it would be vitiated if not exactly reversed by such winds.

There is also a class of visual observations which seem to show an effect upon rainfall by the forest. Probably many have seen heavy clouds passing over a plain, but which only precipitated as they passed over a forest. Also in a hilly region it is a frequent phenomenon that fog and low-lying cloud hover near a forest, and not over a clearing. One also notes very often in passing into a forest on a damp day that the trees

drip moisture, possibly condensed from moisture evaporated from the damp earth underneath. Observations of this nature, however, cannot ordinarily be checked by instrumental means, but show in a general way that the forest tends to conserve vapor and moisture, which in the case of the open field would be diffused into the atmosphere.

STREAM FLOW IN RELATION TO FORESTS.

By MR. GEO. S. RAFTER, C. E., Rochester, N. Y.

[Read at Nashville meeting, September, 1897.]


The general subject announced in the title to this paper has been discussed by Mr. Thomas P. Roberts, at the Boston meeting, in September, 1885, and also by Mr. C. C. Vermeule, at the annual meeting for 1895, and by others. I wish to address myself particularly for a moment to the views announced by Messrs. Roberts and Vermeule. The position taken by these two gentlemen is in effect that forests influence stream flow only in a very slight degree, or not at all. My proposition, on the contrary, is that forests not only do influence stream flow, but that the influence is so exceedingly marked, that of two contiguous New York State drainage areas, one in forest and the other deforested, the deforested area may show as much as five or six inches less annual runoff because of change in water yielding capacity due purely to deforestation. If it is true that there is such a difference as this, not only should the fact be well understood by everybody, but gentlemen taking the contrary view may well cease to advocate the error, if on no other ground than that error once announced is persistent and will require labor to eradicate. In attempting to show the contrary of the proposition championed by Messrs. Roberts and Vermeule, I shall refer extensively to data gathered during the past four years in the state of New York.

Let us first briefly consider the views of Mr. Roberts. This author begins by stating that he "will not undertake to deny that the conservation of the rainfall in local districts is aided by forests," but he attempts to distinguish between local rains and general storms and between summer, fall, winter and spring floods. On such a basis he arrives at the final conclusion that "the popular opinion no doubt will long be that the destruction of forests increases the height of floods, but I am persuaded it is not a belief founded on established fact." Mr. Roberts' position, as defined throughout his paper, is that rainfall is conserved by local districts, but that for large areas several thousand miles in extent there is such a balance of conditions as to lead to essentially the same result, whether the area is forested or deforested. I shall myself show further along that this view is in some degree true, but for reasons totally different from those urged by Mr. Roberts, whose views are so far, indeed, from representing the actual fact that we may say, in effect, that he has totally misapprehended the real significance of the phenomena.

Mr. Roberts devotes a considerable portion of his paper to controverting the views of Sir Gustave Von Wex, Imperial and Royal Ministerial Councillor of Austria and chief engineer of the Improvement of the Danube river at Vienna, who in a splendid series of papers has discussed the whole question of deforestation with reference to its effect upon streams in a more thorough manner than can be found elsewhere; and while it is true that some of his conclusions have been disputed, he still gives on the whole a larger body of facts bearing upon this question than can be found in any other place.*

Inasmuch as Mr. Roberts has stated a number of the main points of Von Wex's chief paper, I will not expend time in further referring to that phase of the matter here.

In combatting Von Wex's views, Mr. Roberts relies mostly upon records of the Ohio river and its tributaries, the tabulations which he gives being records of gage and flood heights kept at various points on the Allegheny and Ohio rivers, as,

*For reference to Von Wex's several papers see foot note on page 645, of report on Genesee Storage Surveys, appendix 7 of the annual report of the State Engineer and Surveyor of the State of New York, for the fiscal year ending September 30, 1896. 

for instance, at Oil city, Freeport, Pittsburgh, Wheeling, Marietta, Point Pleasant, Portsmouth, Cincinnati, Louisville, Evansville and Cairo. On incomplete evidence derived from the records of a single stream, many of which are somewhat conflicting, Mr. Roberts brushes away the entire work of Von Wex so easily, that I cannot but look upon his positive final conclusion as being in the nature of a joke, the more especially since he begins his paper with one. Mr. Roberts' faith in his own views may be inferred when I mention that Von Wex has given the data for from 50 to 100 years of the principal rivers of Europe. Without wishing to disparage Mr. Roberts' views in any way, I may still venture to say that they are, in my opinion, so far from representing the real state of the case, that I should not trouble myself to controvert them at all except for the reason already stated, that error once fixed in the mind is sometimes difficult to eradicate.

The paper of Mr. C. C. Vermeule, to which I have referred, treating on the general subject, may be found in volume XI of the Proceedings of this Association. In combatting the views of Mr. Vermeule, I desire to say that I have a very high appreciation of the labors of that gentleman in connection with questions relating to yield of streams. I have read his various reports with considerable interest, and profited greatly thereby. On this particular point of the relation of forests to stream flow, I cannot but think he is entirely wrong, possibly due to the fact that the New Jersey data on which he chiefly bases his conclusions, are too restricted in their scope to give any certain conclusions on the point in question whatever. By way of illustrating this statement, I may merely refer briefly to two points:

(1) Mr. Vermeule announces in the paper in question, and also in several of his reports, appearing in the annual reports of the Geological Survey of New Jersey, what he calls the discovery, that there is a definite, certain relation between temperature and the total loss of water from a drainage area which he has properly designated under the general term evaporation, the word evaporation, in this case, meaning absorption by plants, evaporation proper, and various other losses.

(2) Mr. Vermeule also states that he knows of no more accurate way to compare the relative total evaporation from for-

ested and deforested areas than by measuring the rainfall in comparison with the runoff, the difference of the two making total evaporation as defined in the preceding. In this way, he says, we obtain natural conditions, and include in our computations not only direct evaporation from the soil, but also the water absorbed by vegetation, much of which is exhaled into the atmosphere. He also holds that this method is far preferable to the attempts to measure evaporation on a small experimental scale, which have frequently been made. Working on this line, he ignores all of the valuable data on forest meteorology which have been obtained abroad and which, in my opinion, cannot be safely ignored by any person attempting to study this question on its merits. However, by ignoring such data and basing conclusions only on a comparison of rainfall with runoff, as determined by several series of gagings of streams extending over a number of years, Mr. Vermeule is forced to conclude "that the effect of our New England and Middle state forests upon the total runoff of streams, hence upon evaporation, is not important enough to be shown in the measurements of stream flow." I cannot but think that in stating this proposition so strongly, Mr. Vermeule has in reality—although without doubt inadvertently—written that which, on the whole, tends to perpetuate an exceedingly mischievous error. I hold, indeed, that had he studied the subject more broadly he would, with his fine turn for philosophical analysis, have arrived at quite different conclusions. In proving this proposition, Mr. Vermeule depends upon data derived mostly from observations in New Jersey. My first criticism of his data is that, with the exception of the records applying to the drainage areas of the Passaic and Hackensack rivers, the periods covered are entirely too short for any final indication whatever. Certainly, they are far too short for any such sweeping generalization as that just quoted. The Passaic records which he cites in his report on forestry in Northern New Jersey, in the annual report of the State Geologist of the State of New Jersey for the year 1895, covers a period of 17 years, while the Hackensack river record covers a period of 8 years. The other New Jersey data studied cover periods as follows: Ramapo river, 2 years; Pequamock river, 3 years; Musconnetcong river, 2 years; Pequest river, 2 years; Paulins Kill river, 2.5 years; Raritan

river, 4 years; Delaware river, 4 years; Great Egg Harbor, 3 years.

For data derived from other states, Mr. Vermeule cites the following: the Sudbury river, in Massachusetts, a 16-year record; Croton river, New York, 14 years; Connecticut river, 13 years; the Nashaminy creek, Pa., 7 years; Perkiomen creek, Pa., 7 years; Potomac river, 6 years. In regard to the Sudbury and Croton, I shall cite you directly records covering, for the Sudbury, a period of 21 years, from 1875 to 1895 inclusive, and for the Croton, records covering a period of 27 years, from 1870 to 1896 inclusive.

In addition to the Sudbury, in Massachusetts, I shall also cite you two other Massachusetts records, namely, the Lake Cochituate and Mystic lake records. The Lake Cochituate watershed is adjacent to the Sudbury, and subject to substantially the same meteorological conditions, while the Mystic lake watershed is distant from 20 to 30 miles and somewhat nearer the ocean than the Sudbury and Cochituate areas. The Cochituate record covers the period of 33 years, from 1863 to 1895 inclusive; while the Mystic lake record covers a period of 18 years, from 1878 to 1895, inclusive.

As stated by Mr. Desmond FitzGerald, the Sudbury river has a drainage area of 75.2 square miles; the Mystic, 26.9 square miles, and the Cochituate, 18.9 square miles, the three together forming the present source of Boston's water supply. The Sudbury is hilly, with steep slopes, with some large swamps within its borders. The Cochituate, although adjoining the Sudbury, is entirely dissimilar. The slopes are flat and sandy, with the surface mostly modified drift, while the Sudbury is mostly composed of unmodified drift. The Sudbury and Cochituate watersheds are northwest of Boston, while the Mystic lies to the north of Boston, about 30 miles distant from the Sudbury and Cochituate. The surface of the Mystic watershed is steeper than the Cochituate and less steep than the Sudbury. In order to determine whether there was any easily traceable relation between mean temperature, rainfall, runoff and evaporation, I have tabulated the records of not only these three drainage areas, but of all other drainage areas considered, in the following manner: The months from December to May, inclusive, are taken as the storage period; June to August, in-

clusive, make the growing period, while September to November, inclusive, make the replenishing period. In the storage period the temperature is low and the runoff a very large per cent. of the total rainfall. In the growing period vegetation is active and temperature high, and the runoff is only a very small per cent. of the total rainfall. In the replenishing period vegetation is inert and the temperature decreasing, with a consequent increase in the amount of rainfall appearing in the runoff. For each year I have tabulated under the foregoing divisions the mean temperature of each month, the total precipitation for each month, the total runoff for each month, and the evaporation of each grand division—that is to say, the total evaporation for the storage period, the growing period, and the replenishing period, as well as the mean temperature for the whole year. Confining ourselves for the present to the Sudbury, Cochituate and Mystic drainage areas, we are struck, first of all, with the fact of the exceeding persistency of the evaporation element. By way of showing this saliently, we may consider the following means for each of these three streams, beginning with the Sudbury. For this stream we have for the

	<i>Rainfall.</i>	<i>Runoff.</i>	<i>Evaporation.</i>
Storage period.....	23.28	17.58	5.70
Growing period.....	10.82	1.66	9.20
Replenishing period.	11.72	3.02	8.70
Total.....	45.86	22.26	23.60

For the Cochituate area the figures are as follows:

	<i>Rainfall.</i>	<i>Runoff.</i>	<i>Evaporation.</i>
Storage period	23.08	14.89	8.19
Growing period.....	11.44	2.14	9.30
Replenishing period.	12.31	3.37	8.94
Total.....	46.83	20.40	26.43

For the Mystic area the figures are:

	<i>Rainfall.</i>	<i>Runoff.</i>	<i>Evaporation.</i>
Storage period.....	22.41	15.08	7.33
Growing period.....	10.85	2.25	8.60
Replenishing period.	10.81	2.61	8.20
Total.....	44.07	19.94	24.13

From the foregoing tabulations, we learn that the mean rainfall of the Sudbury area for the period covered was 45.86, the mean runoff was 22.26 inches, and the mean evaporation, 23.60 inches. For the Cochituate the mean rainfall was 46.83 inches, the runoff 20.40, and the evaporation 26.43 inches. For the Mystic area, the mean rainfall was 44.07 inches, runoff 19.94 inches, and the evaporation 24.13 inches. From these figures we learn that the mean rainfall of the Cochituate area for the period of 33 years was 1.03 inches greater than the mean rainfall for the Sudbury for 21 years. The mean runoff of the Cochituate for the same period was 20.40 inches, as against 22.26 inches on the Sudbury, or, in spite of the fact that the mean rainfall of the Cochituate was 1.03 inches greater for the periods considered than that of the Sudbury, still the mean runoff of the Cochituate was 1.86 inches less than that of the Sudbury.

The temperature records at hand for these three drainage areas are not entirely satisfactory, no record having been kept for the Sudbury and Cochituate previous to 1881, since which time a record has been kept at South Framingham. In order to fill out the tabulations complete, the temperature record used previous to 1881 is that kept at Cambridge, Massachusetts. Basing our conclusion on such data, we obtain a mean temperature for the Sudbury drainage area of 47 degrees F.; for the Cochituate area, a mean temperature of 47.7 degrees F.; for the Mystic area we have a complete record from 1878 to 1885, inclusive, and for the balance of the time I have used the Chestnut Hill reservoir record, whence we obtain a mean temperature of 48.5 degrees F.

A study of the detailed records on a number of different lines has thus far failed to show for these three areas any clear relation between temperature and runoff. The indications, on the contrary, are, as might be reasonably expected when one studies the question broadly, that there are a number of other elements of so much importance as to make temperature only of secondary importance. It is not intended to say, however, that there is not some relation between temperature and runoff, but it is intended to say that Mr. Vermeule's conclusion that the whole matter is simply one of relation of temperature, is so far

from the fact as to in effect invalidate any conclusion he may have put forth on the subject under discussion.

In regard to the persistency of the evaporation element, we may note that on these three Massachusetts drainage areas the evaporation groups itself at about the same point. For the Sudbury the mean evaporation for the whole period considered is, as shown, 23.60 inches. The minimum year of the whole period considered was 1883, when the runoff for the storage period was 9.70 inches; for the growing period, 0.86 inches; and for the replenishing period, 0.84 inches, giving a total of 11.40 inches for the whole year. The rainfall for that year was, storage period, 16.78 inches; growing period, 5.61 inches; replenishing period, 8.93 inches, giving a total of 31.52 inches for the whole year. Even with a rainfall of only 31.52 inches in 1883, still the evaporation rose to 20.12 inches, or to only 3.48 inches less than the mean, while the rainfall for the same year was 14.34 inches less than the mean. If we trace out the figures of the Cochituate and the Mystic areas, we shall find the same interesting fact, namely, that in years of low rainfall the persistency of the evaporation element is such that it must be essentially satisfied first of all before any water can run off, and, further, that the evaporation element is so exceedingly persistent that it only varies in a small degree from year to year.

The Sudbury, Cochituate and Mystic drainage areas are not heavily timbered. As to just the proportion of timber on each, I am not at present able to present the figures, but as the result of journeying over these areas a number of times, I should say, albeit in a somewhat offhand way, that the proportion of timber is so small as to exercise comparatively little influence on the runoff, it being apparently well established that drainage areas which are nearly denuded, or, at any rate, so far denuded that the winds sweep freely through the small quantity of timber remaining are substantially in the same condition as completely deforested areas. Assuming, then, that the mean temperatures of these areas are substantially as stated, we must conclude that the differences in runoff which appear are due almost entirely to marked difference in character of soil of the drainage areas. In view of the long records available for these three Massachusetts areas, we must conclude, further, that, as regards them, at any rate, there are elements other than the

temperature, of more importance, which Mr. Vermeule has unfortunately stated as of no importance at all.

Space will not permit of pursuing the analysis of the Massachusetts records to any length. For the benefit of those interested in the general subject, I may state that the tabulations referred to are given in full detail in a report to the Honorable State Engineer and Surveyor and the Honorable Superintendent of Public Works of the State of New York, on the Upper Hudson Storage Surveys, which will appear in the annual report of the State Engineer and Surveyor for the fiscal year ending September 30, 1896, and which will be issued in two or three weeks. A large amount of additional data, to some of which I shall refer in the succeeding pages of this paper, are also given in the same report, as well as in the report on the Genesee river storage contained in the same volume. All of this data, so far as used in the present paper, I have been permitted to use in advance of its publication in the reports of the department, by courtesy of the Honorable State Engineer and Surveyor.

We may now refer to some of this data gathered in the State of New York, considering first the drainage area of the Upper Hudson river. In 1895, the Legislature made an appropriation for the purpose of surveying and examining that portion of the Upper Hudson drainage area within the boundaries of the State of New York, with a view to determining the practicability and expense of constructing a series of storage reservoirs, to furnish water for the enlarged Champlain canal, as well as to compensate the manufacturers on the stream below the point where water for the Champlain canal is taken, on account of the diversion for the use of that canal. The surveys in question have thus far been in my charge.

In order to ascertain the mean temperature of the Upper Hudson drainage area, I have gathered all available temperature records, as, for instance, those of Albany, from 1825 to 1875 inclusive, a period of 71 years; Glen falls, from 1879 to 1895 inclusive, a period of 17 years; Keene valley, from 1879 to 1895 inclusive, a period of 17 years; Fairfield academy, for certain years from 1827 to 1849, in all 19 years; at Lowville academy, from 1827 to 1848, in all 19 years; Johnstown academy, certain years from 1828 to 1845, in all 14 years; Granvill academy, from 1835 to 1849, a period of 15 years; at

Cambridge academy, certain years from 1827 to 1841, making in all 14 years. The monthly means have been carried out, as well as the yearly means, giving as a yearly mean of all, 45.6 degrees F. A number of the foregoing stations are, however, not in the Upper Hudson drainage area, but in or near regions of similar elevation and general meteorological characteristics, and without doubt represent very nearly the mean temperatures of the adjacent regions actually lying within the Upper Hudson drainage area. Mean temperatures have also been kept by the State Weather Service at Saranac lake and at a number of other points, either in, or in the vicinity of the Hudson river drainage area. Tabulations of the same are given in the Hudson Storage Survey reports. The mean temperature of the Northern Plateau, as defined by the State Weather Service, and which includes the Adirondack region, on and in the southern slope of which the Hudson river takes its rise, has also been taken into account. The State Weather Service observations only begin in 1889, and the period covered to date is, therefore, too short for final conclusions. The record, so far as kept at Saranac lake, indicates a mean temperature there of 41 degrees F. For tentative purposes, it may be taken at from 42 degrees to 43 degrees F.

In order to obtain the mean precipitation on the Upper Hudson watershed, the available rainfall data have been treated in a manner similar to that already described for the mean temperatures, with the result of showing that for Albany, Glens falls, Keene valley, Western Massachusetts, the Northern Plateau, Lowville academy, Johnstown academy, Cambridge academy, Fairfield academy, Granville academy, and for a number of other places, with short records, not now specifically stated, but which may be found in detail in the reports, the mean rainfall is about 37.5 inches. For the few years covered by the records of the State Weather Service, the means are about 40 inches, but the objection already stated to the unqualified use of short temperature records applies with equal force to rainfall records. As regards both, the general proposition is that we must gather data covering a sufficient number of years to give a mean, which will not be essentially altered if we carry the observations to any greater number of years whatever. On this point, I cite you to a paper on Fluctuations in Rainfall, read by Alexander

Binnie, Esq., C. E., before the Institution of Civil Engineers of England, in 1892, and which may be found in volume CIX. of the Proceedings of that Institution.

In this paper Mr. Binnie takes up a number of long rainfall records, and by analysis of them, arrives at the conclusion that a rainfall record only 5 years in length may be subject to a possible error of 32 per cent.; a ten years' record to an error of 7.7 per cent.; a 25 years' record to an error of 5.8 per cent.; a 35 years' record to an error of 2.5 per cent.; a 40 years' record to an error of 2.9 per cent.; a 45 years' record to an error of 2.6 per cent., and a 50 years' record to an error of 2.5 per cent. Hence, Mr. Binnie concludes that a carefully kept rainfall record 35 years in length is as good as a record for a longer period, and that safe conclusions may be based upon such a record within the limit of an error of about 2.5 per cent. It is carefully worked-out conclusions of this character which indicate the uncertainty of basing anything final on records of two or three years, and a thorough appreciation of the importance of this proposition has led me to question the validity of the conclusions of Messrs. Roberts and Vermeule. I doubt their conclusions because analysis shows that neither have used data of sufficient extent to indicate safe conclusions.

In regard to the runoff of the Upper Hudson river, we have a fairly complete record from 1888 to 1896, inclusive. By way of comparison of runoff with temperature and precipitation, I have tabulated, in the manner already detailed for the Sudbury, Cochituate and Mystic areas, the mean temperature, precipitation, runoff and evaporation for the years 1891 to 1896, inclusive, using the temperature and precipitation of the Northern Plateau, as given by the State Weather Service in its monthly publication. In 1891 the total rainfall was 42.96 inches; the total runoff 20.56, and the evaporation 22.4 inches.

In 1892 the total rainfall was 53.87, the runoff 33.08, and the evaporation 20.79 inches. A comparison of the two years, 1891-92, as regards the evaporation, is exceedingly interesting. The rainfall in 1892 was 10.91 inches, while the evaporation was only 0.39 greater than in 1891; that is to say, as already pointed out, in discussing the Massachusetts data, the evaporation is persistent at about the same figure, whatever the rainfall may be. For instance, as illustrating this position further, we may

take the year 1893, when the total rainfall dropped to 42.18 inches, or within 0.78 inches of what it was in 1891, whereupon the evaporation showed 20.27 inches, or practically the same figure as in 1891. In 1894, however, somewhat different meteorological conditions prevailed, and with a rainfall of 41.37 inches the evaporation rose to 22.60 inches. In 1896, when the rainfall rose to 45.21 inches, the evaporation was 21.58 inches. The mean evaporation of the six years covered is 21.14 inches. We may say, then, as a tentative conclusion, subject to correction up to the period when we shall have at hand about 35 years' data, that the evaporation on the Upper Hudson area may be placed under present conditions at about 21 or 22 inches per year. In regard to the forestation of this area, it may be stated that the portion in the State of New York has an average of about 80 per cent. in forest. Different parts of this vary considerably. The area of the Schroon river, amounting to 560 square miles, is about 75 per cent. forest; the area of the Upper Hudson, or main North river, including 1200 square miles, is about 85 per cent. forest, some of it being nearly unbroken primeval forest; the area of the Sacandaga river, which is about 1100 square miles, and which is still largely primeval forest, is fully 90 per cent. forest, the clearings here being probably scant 10 per cent. of the whole. The balance of the Upper Hudson area in the state of New York is from 65 to 70 per cent. forest. That portion of the area included in Western Massachusetts and Southern Vermont is stated at about 50 to 60 per cent. forest, giving as a mean something like 80 per cent. forest for the whole. Of the several sub-divisions of the Upper Hudson drainage area, the Sacandaga river is distinctly the best water yielder. As regards evaporation, we may say, therefore, with the limitations already made as to final definite conclusions, that a drainage area of 4500 square miles, averaging 80 per cent. forest, may be expected in the latitude of Northern New York to give an evaporation loss of from 21 to 22 inches per year.

Let us now consider the data of the Genesee river, also in the State of New York. Surveys of the headwaters of this stream, with reference to constructing storage reservoirs thereon, were first made by the State Engineer and Surveyor's department in 1890. In the absence of appropriations, nothing further

was done on these surveys until 1893. In that year other appropriations became available, and the work was placed in my charge, and has so remained from that time to the present. A large amount of data has been gathered, which may be found (1) in the annual report of the State Engineer and Surveyor of the state of New York for the fiscal year ending September 30, 1893; (2) in the annual report for 1894; (3) in the annual report for the year 1896, to be published in a few weeks. Gagings of this stream and one of its tributaries, known as the Oatka creek, are available for the years 1890-91-92-94-95-96, the record for 1890 to 1892 inclusive being that of the Oatka creek, and the record of 1894 to 1896 inclusive being that of the main Genesee river. The total area above the point of gaging on the Oatka creek is 27.5 square miles, but this area is so located that its runoff may be fairly considered typical of that of the entire Upper Genesee drainage area, and, hence, the figures given are fairly applicable to the whole. The drainage area of the main river itself, above the point of the gaging, is 1070 square miles. These drainage areas are rolling, somewhat mountainous country, with deep valleys and high hills. The average elevation of the Oatka creek drainage area is about 1500 feet above tide water, while the Upper Genesee area above the point of gaging will average perhaps 1700 to 1800 feet above tide water. For the year 1890 the rainfall of the Oatka creek drainage area is taken at 47.54 inches. The gagings are not complete for that year, but so far as available, give the following: For the growing period, June to August, inclusive, a runoff of 2.51 inches; for the replenishing period, September to November, inclusive, 5.75 inches. For the year 1891 the total rainfall was 38.12 inches, with a runoff of 14.05 inches and an evaporation of 24.07 inches. In 1892 the rainfall was 41.69 inches, the runoff 15.42 inches, and the evaporation 26.27 inches. These figures are exceedingly interesting. Although the rainfall for 1892 was 3.57 inches greater than in 1891, still the runoff was only 1.37 inches greater, the evaporation in 1892 being 2.20 inches in excess of 1891, or a total of 26.27. The mean temperatures of the years 1891 and 1892 were practically the same, being 45.70 degrees F. for 1891, and 45.40 degrees F. for 1892.

Taking the runoff of the entire Upper Genesee drainage area of 1070 square miles, we have the following:

	<i>Rainfall.</i>	<i>Runoff.</i>	<i>Evaporation.</i>
1894.....	47.79	19.38	28.41
1895.....	31.00	6.67	24.33
1896.....	41.68	12.80	28.88

The foregoing figures are again interesting as illustrating the persistency of the evaporation element, without regard to temperature; thus in 1894, with a rainfall of 47.79 inches, the evaporation from the Upper Genesee area was 28.41 inches. Again, in 1896, when the rainfall was 41.68 inches, the evaporation was 28.88 inches; but in 1895, with a rainfall down to the probable extreme minimum of only 31 inches, the evaporation fell to 24.33 inches. Taking into account, then, that three years is not a sufficient length of time to give final conclusions, we may say, as a tentative proposition purely, that, on the Upper Genesee area, with full or nearly full rainfall, we may expect a yearly evaporation of something like 26 to 28 inches, but when the yearly rainfall is at or about its minimum, the evaporation will probably fall to about 24 inches. Comparing these figures with those already given for the Upper Hudson area, we may draw the further tentative conclusion that **the difference in evaporation between the Upper Hudson area and the Upper Genesee area is something like 5 or 6 inches per year, this difference representing approximately the difference in the State of New York between a forested and a deforested area.** In considering the significance of this tentative conclusion, we should bear in mind that the Upper Genesee area is practically bare of forest.

The data of the Croton river may also be referred to. For this stream I have tabulated the rainfall, runoff, evaporation and temperature for a period of 27 years, from 1870 to 1896, inclusive. The data of such tabulation, as derived from the records of the Croton Water Department, have been properly corrected for the storage of the several reservoirs on that area, so that the figures given in the table represent the true runoff of the stream. The average annual rainfall of the Croton area may be taken at 48.40 inches, and the average runoff of the river for 25 years at 24.6 inches, the difference of the two representing the evaporation, amounting to 23.8 inches. In 1883,

with a rainfall of 43.15 inches, the evaporation amounted to 27.2 inches. In 1888, with a rainfall of 63.5 inches, the evaporation amounted to 25.7 inches, but in 1880, with a rainfall of only 38.50 inches, the evaporation still amounted to 23.20 inches. Speaking generally, we may say, therefore, that the evaporation of the Croton area is persistent at about 24 inches per year, which demand must be satisfied so long as the area remains in its present condition, and before there is much surplus water to appear as runoff. The area of the watershed above the point of gaging is 338 square miles, and the percentage of timber area does not exceed about 25 per cent. A considerable portion of this is wild land covered with such scant forest growth and brush as to afford very little protection. Hence we may say that such forest growth on the Croton area as has value in conserving stream flow probably does not much exceed about 20 per cent. There is, however, between 2 and 3 per cent. of storage on reservoir surfaces, which has some effect on the aggregate runoff. Generally the Croton area is hilly, with the rock mainly gneissic, overlaid with drift and gravel frequently to considerable depth. There are also some swamps.

As another interesting stream in the Eastern United States, we may mention the Muskingum river, in Ohio, of which records are available from 1888 to 1896, inclusive. This stream mostly issues from the flat areas of Central Ohio, where there is very little timber, and shows such lower runoffs as may be expected from that kind of an area. In 1888, with a rainfall of 42.60 inches, the evaporation amounted to 32.28 inches. The runoff for that year was 10.33 inches. In 1889, the rainfall was 35.88 inches, the runoff 8.22 inches, and the evaporation 27.66 inches. In 1890, the rainfall was 56.97 inches, the runoff 26.84 inches, and the evaporation 21.80 inches. In 1892, the rainfall was 41.74 inches, runoff 13.38 inches, and evaporation 28.36 inches. In 1895, the rainfall was 42.36 inches, runoff 16.20 inches, evaporation 26.16 inches. In 1894, the rainfall was 30.51 inches, the runoff 8.70 inches, and the evaporation 21.81 inches. In 1895, the rainfall was 29.84 inches, the runoff 4.90 inches, and the evaporation 24.94 inches. For the year 1896, the data, although at hand, has not yet been reduced.

As we have already seen, the Upper Genesee river, in Western New York, gave in 1895, with a rainfall of 31 inches, a run-

off of only 6.67 inches. On the Muskingum river for that year, with a rainfall of 29.84 inches, the runoff was only 4.90 inches. The evaporation of the Genesee river, in 1895, was 24.33 inches, and of the Muskingum river, 24.94 inches. The year 1895 was undoubtedly the year of about minimum rainfall for both these drainage areas; hence we may draw the tentative conclusion that on deforested areas, for the belt of country included by these two streams, the evaporation will be for the year of minimum rainfall somewhere in the vicinity of 24 to 25 inches. After this element is satisfied, whatever surplus there may be will appear as runoff in streams. This conclusion, it must be remembered, applies only to these areas, while in their present deforested state. The mean temperature of the Genesee area is about 45 degrees F., and that of the Muskingum from 48 degrees to 50 degrees F. The incomplete state of the tabulations to which I have referred render it impossible to give the final figures at this time. The drainage area of the Muskingum river is about 6000 square miles. A considerable portion of this area is of a clayey character, the surface formation being that known to the State Geologists as boulder clay. In many places it exists to a great depth, and is stated to have radically changed the preglacial courses of the streams. It has little porosity, and water sinks into it with difficulty. Springs are rare, and by the middle of July many of the streams dry up, and so remain until late in the fall. A considerable portion of the Muskingum drainage area has been thoroughly underdrained by tile drainage.

As another stream, we may refer to the Des Plaines river, in Illinois, of which more or less complete gagings have been kept, from 1886 to 1897, inclusive. In 1889, the mean rainfall of the Des Plaines drainage area, as deduced by taking the means of a large number of stations in Illinois and Wisconsin, was 34.99 inches; the runoff 5.06 inches, the evaporation 29.93 inches. In 1893, the rainfall was 26.96 inches, the runoff 10.14 inches, and the evaporation 16.82 inches. In 1894, the rainfall was 27.94 inches, the runoff 7.70 inches, the evaporation 20.24 inches. In 1896, the rainfall was 39.58 inches, the runoff 6.69 inches, and the evaporation 32.89 inches. As a tentative conclusion, we may say, then, that, with full rainfall, the Des Plaines river drainage area will show an evaporation in its

present deforested state of about 30 inches per year. With deficient rainfall, the evaporation will be less in proportion to the deficiency.

The reservoirs on the Upper Mississippi may also be referred to. Taking the records as kept at the Pokegama dam, where the total area of contributing watershed is 3265 square miles, with about 585 square miles of water surface, included in the lakes and reservoirs above the Pokegama dam, we have for the period of 11 years, from 1885 to 1895, inclusive, a mean rainfall of 25.06 inches. The runoffs for this period have not yet been computed for inches on the watershed, but as a general statement, we may say 25 inches of rain a year yields from this area from 4 to 5 inches of runoff. In years of minimum rainfall, when the total is as low as about 20 inches, the runoff does not exceed 3.5 inches. The area drained by the Upper Mississippi is now mostly heavy forest, with a mean temperature of from 38 degrees to 40 degrees F. If the forest were entirely removed, there is no reason to doubt but that streams in this area, which now yield some water during the entire summer season, would become entirely dry during a considerable portion of the year, the same as is true of many of the tributary streams of the Muskingum and Des Plaines rivers.

The astonishing persistency of the evaporation element for given conditions was, so far as I am aware, first pointed out by Messers. Lawes, Gilbert and Warrington, in their classical paper on the Amount and Composition of the Rain and Drainage Waters Collected at Rothamsted, and published in the Journal of the Royal Agricultural Society of England, in 1881. The reason for this persistency is considered by these distinguished authors largely due to the fact that the two principal conditions which determine large evaporation, namely, excessive heat and abundant rain, very rarely occur together; the result is, especially in the English climate, a balance of conditions unfavorable to large evaporation. In a wet season, when the soil is kept well supplied with water, there is at the same time a more or less saturated atmosphere, with an absence of sunshine, while in dry seasons the scarcity of rain results in great dryness of the soil, with scant, slow evaporation.

The problem of the relation of rainfall to runoff and evaporation has attracted the attention of meteorologists and working

engineers for many years, and in England and some of the other countries of Europe, records have been kept as far back as 50 to 70 years ago, and the results tabulated with reference to a solution of this problem. Among other interesting data, a large amount of which has been obtained in England, we may refer to percolation data as derived from the use of drain gages. In the paper by Messrs. Lawes, Gilbert and Warrington, already referred to, we have a record of rainfall and the percolation through the Rothamsted drain gages from 1870 to 1890. Space will not permit of describing these interesting experiments in this place, but those interested in them may find the whole matter in detail in the original paper in the *Journal of the Royal Agricultural Society of England*, already referred to, or an abstract may be found in my second report on the survey of the Upper Hudson valley, as included in the annual report of the State Engineer and Surveyor of the State of New York for the year 1896, and about to be published. At Rothamsted, where these experiments have been carried on, the average rainfall for 21 years was 30.29 inches. The mean percolation for the same period, through a drain gage 40 inches in depth, was 15.16 inches, leaving a mean evaporation for the period of 15.13 inches. The maximum evaporation for the whole period is 19.63 inches, or 4.50 inches more than the mean; the minimum evaporation was 11.03, or 4.10 inches less than the mean. The maximum runoff throughout the drain gage was 26.03 inches in the year 1878-79, when the rainfall was 41.05 inches, the evaporation for that year being 15.02 inches, or within 0.11 inches of the mean. The minimum runoff through the gage was 5.40 inches in 1873-74, when the rainfall was 21.69 inches. We learn from these figures the much greater range of the runoff than of the evaporation; that is, the maximum runoff was 10.87 inches greater than the mean runoff, and the minimum 9.76 inches less. Hence, the range of the runoff above and below the mean is more than twice the range of the evaporation above and below the mean. If we examine the several tabulations of stream flows in the United States already referred to, we shall find a somewhat similar law running through the whole series, which again not only illustrates the extreme persistency of the evaporation element, but shows that evaporation from a drainage area is broadly independent of temperature.

Many other interesting drain gage experiments have been made in England which cannot be referred to in this place for lack of space. A fairly complete *resume* of the data may, however, be found in the forthcoming Upper Hudson River Storage report. The runoff data of a number of foreign streams are also referred to in the same report.

Lack of space necessarily prevents presenting anything like complete figures at this time, and I may, therefore, simply state that as the result of making very extensive tabulations of data, I reach the conclusion that the deforestation of a drainage area will, in the State of New York and in that vicinity, probably decrease the annual water yield of that area from four to six inches. This conclusion, I desire again to say, is tentative, such as may be drawn from the data at hand. It is merely what a broad study of the data indicates, and I reserve the right to modify it as further data are gathered. It may also be drawn from the data studied by Vermeule, when the said data is studied broadly.

We have seen in the foregoing that some, at any rate, of the current views as to the relation of forests to stream flow may be properly modified. As a final division of this present discussion, I desire to lay before you briefly my present understanding of how it is that deforestation may not only affect floods, but that it also leads to an actual decrease in total runoff.

In the first place, the classical experiments on forest meteorology which have been made abroad by Dr. Ebermayer and others, have shown a considerable decrease in the mean temperature of the air within and without forests. If, then, Mr. Vermeule's proposition that there is a direct relation between temperature and runoff is correct—so marked a relation, indeed, that a difference of one degree in mean temperature will make five per cent. difference in the annual runoff from a given drainage area—it follows, with the certainty of a proposition in geometry, that forests must have a marked effect on the runoff. Moreover, the forest meteorological observations have further shown that evaporation, not only from water surfaces, but from bare as well as littered soils, is very much less in thick forests than in the open. The effect of the forest is here exceedingly marked. Indeed, it has been shown that as a mean of the months from April to October, inclusive, evaporation from

soil under forest litter within the forest is only 13 per cent. of what it is from a water surface in the open, whereas evaporation from the bare soil in the open is 93 per cent. of what it is from a water surface in the open. Again, a water surface in the woods, in localities where the water is fairly surrounded by heavy timber, gives only 36 per cent. of the evaporation, from April to October, inclusive, that occurs on a similar water surface in the open. Mr. Vermeule and the gentlemen championing the other view may ignore data of this character if they wish to, but I fail to see any justification for such neglect of the data.

As further data which cannot be safely ignored, we may refer to some of the results obtained by Mr. FitzGerald in his evaporation experiments at Boston. In determining winter evaporation, Mr. FitzGerald found by experimenting upon blocks of ice, that, when the blocks were so placed as to be subject to air currents, the loss was much greater than when exposed to the same temperature in still air. These results appeared even at zero temperature. We may apply them directly to a drainage area, where, when the same is covered with primeval forest, the force of the wind is so much broken as to make a distinct difference in the wasting away of snow during the winter. As illustrating the possible magnitude of such loss, we may cite that on one occasion Mr. Fitz Gerald found evaporation from an ice surface, with the wind at 12 miles an hour, proceeding at the rate of 0.2 inches per day. A number of experiments were made as to the evaporation from ice exposed to wind in comparison with evaporation from the same substance when protected in a covered and cold shed, through and into which the wind could not enter, with the result of showing that the wind was an exceedingly important factor in winter evaporation, and that, therefore, whenever we do anything which tends to give the wind freer access to the snow covering on a drainage area, we have done that which will lead to a large loss of water from the area. It is facts of this character which emphasize the injury done to streams by extensive deforestation.

As to the relation of the foregoing facts to flood flows, we may point out that there is a certain balancing of conditions. Thus, on a deforested area, we may expect the snow falling

during the winter months to so far waste away under the influence of unobstructed winds as to be, when the spring breakup comes, considerably less in quantity than it would be if the area had been protected by heavy forests. The result is that while the snow will melt quicker under the influence of higher spring temperatures than it would if in forest, still the quantity to be melted is, by reason of the said gradual wasting, considerably less than where the opposite condition obtains. On the other hand, with the snowfall protected by a forest covering, the wasting away at time of high spring temperature is slower than on an exposed area subject to the same meteorological conditions. The forest meteorological observations show that this conclusion must be essentially true. We have, then, a set of conditions in which the effect of the forest, in increasing the tendency to extreme flood at the time of the spring breakup by the storage of large quantities of snow, is modified by the greater loss from evaporation taking place on a deforested area during the entire winter season. Hence, as regards floods caused by the sudden melting of winter snows, there is an essential balance, the net result being in the case of deforested areas, a shortening of the time of extreme spring runoff, with, by reason of gradual wasting away during the winter, ordinarily no special increase in height of flood.

As regards floods due to heavy rains, either in the spring or fall, and which occur without reference to the spring breakup, a similar line of reasoning applies. Exposure of the ground of the deforested area leads to a more rapid evaporation from the surface, with quicker exhaustion of the surface moisture. Hence, usually the ground in the open is in good condition at the beginning of an extreme rainfall to absorb considerably more water before large quantities begin to run off than it would be if covered with forest. In this way a balance of spring, summer and fall flood conditions is likewise attained on the deforested area, the same as during the winter. The rational conclusion appears to be easily drawn, therefore, (1) that while deforestation does actually decrease the net annual runoff of streams, still (2) it does not *per se* necessarily materially increase the height of floods. As meeting, therefore, the objection of Mr. Roberts, it remains to point out that the mere fact of non-increase of floods is absolutely no proof that there is not a material decrease in total runoff from deforested areas.

In considering the foregoing views, we must not overlook that thorough drainage of catchment area may so decrease the time of maximum runoff as to increase flood heights. This is especially true in any region where large open drainage ditches have been cut. It is within my experience that the regimen of a stream has been entirely changed by drainage alone. On this point a large amount of interesting and useful data is at hand, but which cannot for lack of space be introduced here.

As another class of data applying to the problem in hand, we may refer to the results obtained in experiments relative to the quantity of water required by different classes of forest trees and by the principal cereals and other farm crops, as well as various grasses, vineyards and potatoes, by E. Risler, who carried on an exceedingly interesting study on these points at his farm near Nyon, Switzerland, a number of years ago. Risler's results may be found cited by Ronna, in his manual "Les Irrigations," also in Risler's paper, "Recherches sur l'évaporation du sol et des plantes," etc., and in other places. The following from Risler, gives the best available information as to the daily consumption of water by various crops and two classes of forest trees, the water being supplied in such quantity as to produce the best result in the growing plants:

	<i>Inches.</i>
Meadow grass requires from.....	0.134 to 0.267
Oats requires from.....	0.140 to 0.193
Indian corn requires from.....	0.110 to 0.157
Clover requires from.....	0.140 to
Vineyards require from.....	0.035 to 0.031
Wheat requires from.....	0.106 to 0.110
Rye requires from.....	0.091 to
Oak trees require from.....	0.038 to 0.035
Potatoes require from.....	0.038 to 0.055
Fir trees require from.....	0.020 to 0.043

Applying these figures, we learn that ordinary farm crops may take up from 12 to 15 inches of water over the whole area cropped during the growing period. Forests in the same way may take up in their growing period from April to August, inclusive, from 4 to 5 inches, while cleared areas which are uncultivated probably absorb from 7 to 8 inches. Forests, then, not only use less water than cultivated areas, but they further tend

to increase the summer flow of streams by holding back the water in accumulations of leaves, mosses and forest litter, until it can be gradually absorbed into the soil. If we examine in detail the figures as to runoff of the Hudson river in comparison to those of the Genesee and other deforested drainage areas, we learn that a forest area may yield more than double the flow during the growing season that will be obtained from a deforested area. Again, on cultivated areas the quality of the leading crop will materially influence the runoff. Thus streams issuing from an Illinois prairie, where Indian corn may occupy from 50 to 60 per cent. of the total area, will give a very different summer flow from streams similarly situated, but issuing from areas with crops demanding less moisture than Indian corn.

If the foregoing data are even approximately true, it follows that in many places the runoff of streams is gradually decreasing, not only by reason of decrease in forest area due to clearing up of lands for agricultural purposes, but is even changing because of the varying quality of crops raised from year to year. The fact that such changes are taking place has been very strongly impressed upon me in a number of litigations in which I have been at different times employed, where the question of damages for diverting water from streams, either for municipal or manufacturing purposes, has been the leading issue. Invariably in such cases a large number of old residents have been sworn as witnesses for the plaintiff, and have testified that formerly, say 30, 40 or 50 years ago, as the case may be, the stream in question had a sufficient summer flow to operate a mill of a given capacity. In Western New York, where several of these cases have occurred, there are many mills from 60 to 70 years old, in which, up to the time of changing from the old-fashioned grinding process to the roller process, the machinery was substantially as it was made at the original erection. However valuable the water privileges at these mills may have been originally, it is nevertheless certain that now a number of them are practically worthless during several months of the summer and fall of the average year. In order to present a valid reason why the water power of streams in Western New York may be less valuable now than 40 or 50 years ago, I prepared for use in one of the litigations, a few years ago, an

extended discussion of this question. The discussion so prepared applies particularly to drainage areas in Wyoming county, in Western New York, the runoff data being from gaggings of the Oatka creek for the years 1890-91-92.

Wyoming county is an elevated region of the same general character throughout. Formerly it was covered with heavy pine, hemlock, oak, beech, maple, ash and elm forests. At the present time, the forest area is exceedingly small, and what there is left of it so scattered and so open as to exercise almost no effect on stream flow. In order to illustrate the progressive changes which may take place in the water-yielding capacity of a given drainage area, I compiled from the U. S. Census, for each decennial period from 1850 to 1890, inclusive, the statistics as therein given for Wyoming county, the assumption being that whatever was true of Wyoming county must be substantially true of the Oatka creek drainage area of 27.5 square miles, situated in the central part of the county. The census data give the total area, total improved area for a portion of the period, tilled area and permanent meadows, total unimproved area, woodland and forest area, and the miscellaneous unimproved area. As illustrating the changes which have taken place in Wyoming county since 1850, I may merely cite from the tabulations that, with a total area of 387,840 acres, the total improved area was 223,533 acres in 1850, and 356,880 acres in 1890. The total unimproved area was 164,307 acres in 1850, and only 30,960 acres in 1890, of which 26,960 was woodland and forest, and 4,000 miscellaneous unimproved area.

Again, the tables show that in 1850 there were 50,035 acres in clover seed and grass seed, wheat, rye, corn, oats, peas, beans, potatoes, barley and buckwheat. While in 1890 the same crops showed 71,915 acres. In 1850, the area in oats amounted to 18,132 acres, while in 1890 it amounted to 29,083 acres. Barley, in 1850, covered 2409 acres, and in 1890, 14,164 acres. Again, the area in hay amounted in 1850 to 62,563 acres, and in 1890 to 80,446 acres. The total tons of hay, in 1850, were 75,076; in 1890, 105,134 tons. Probably the statistics as pertinent as any to the case in hand are those relating to changes in live stock. For instance, in 1850 the total number of milch cows was 10,022, while in 1890, the total

number was 22,919. The total number of horses, mules, milch cows, oxen and other cattle, in 1850, was 40,812, while the total number of all these classes of stock in 1890 was 44,810. Considering the total of hoof cattle, we might say that the increase had not been great, but when we consider the total of improved area in comparison with the unimproved area in 1850, and also in comparison with the amount of stock then and in 1890, we see at once that in 1850 the principal pasture area of the county must have been in forest, whereas the pasture meadow in 1890 must have been, as in fact I know it to have been, largely in permanent meadows. Referring to Risler's results as to the amount of water required for crops, we learn at once the great increase in water demand for supporting crops from 1850 to 1890.

Taking into account the foregoing data, I further prepared a table giving the per cent. that each crop actually raised in 1850 was of the total area in the county, assigning to forest area, fallow land, etc., each its proper area. Similar data have been prepared for each census period to 1890, inclusive. From such tabulation I learned that in 1850 the area in wheat, rye, oats, barley and buckwheat, was 10 per cent. of the whole; Indian corn, 2 per cent.; potatoes, 0.7 of one per cent.; long grass, 16 per cent.; short grass, 20 per cent.; fallow land, orchards, peas, beans and miscellaneous, 11 per cent., and forest, 40 per cent. Without giving the details of 1860, 1870 and 1880, we may pass to 1890, in which year the following percentages were found: Wheat, rye, oats, barley and buckwheat, 7.9 per cent.; Indian corn, 0.7 of 1 per cent.; potatoes, 1.6 per cent.; long grass, 20.8 per cent.; short grass, 33.5 per cent.; fallow land, orchards, peas, beans, miscellaneous, 25 per cent.; clover, 1.5 per cent., and forest, 9 per cent. It will be noticed that the forest area had changed from 40 per cent., in 1850, to 9 per cent., in 1890. Taking Risler's data as a basis, it was then easily computed that wheat, rye, oats, barley and buckwheat would require 9.2 inches of water on the actual area cropped to fully supply their demands; Indian corn would require 12.2 inches; potatoes, 4.3 inches; long grass, 19.3 inches; short grass, 15.4 inches; fallow land, peas, beans, orchards and miscellaneous, 12 inches; clover, 12.9 inches, and forest, 3.6 inches. Proceeding on this line, it was ascertained that in 1850 the total

depth of water over the entire area of Wyoming county, required to fully support vegetation as it existed in that year, amounted to 10.17 inches; in 1860, it amounted to 11.15 inches; in 1870, to 11.89 inches; in 1880, to 13.24 inches, and in 1890, to 13.57 inches. Hence the conclusion seemed to be safely drawn, that in 1890, due to changes in forest area and to quality of crops grown, the amount of water required in Wyoming county to support vegetation during the growing season would amount to 3.4 inches more than in 1850. Why a mill-stream in Wyoming county, which was ample for all demands in 1850, entirely failed in 1890, seemed, therefore, fully explained.

In order to determine whether such conclusion was in accord with the rainfall records of Western New York, a large number of such were tabulated in periods, in the manner already described, with December to May, inclusive, making the storage period; June to August, inclusive, the growing period, and September to November, inclusive, the replenishing period. From a tabulation of the rainfall records kept at Middlebury academy, in Wyoming county, for certain years—17 in all—from 1826 to 1848, inclusive, the mean rainfall for the growing period was determined at 9.52 inches. In 1832 it was only 6.76 inches. The maximum at Middlebury academy was 14.26 inches in the growing period of 1828. Tabulating more recent records, it was found that at Arcade, in Wyoming county, from 1891 to 1896, the mean of the growing period was 13.61 inches, the minimum of 9.62 inches occurring in 1894. At Le Roy, in the adjoining county of Genesee, the mean of the growing period from 1891 to 1895, inclusive, was 10.31 inches, the minimum being 6.61 inches in 1894. At Rochester the records show a mean of the growing period for the years from 1871 to 1896, inclusive, of 9.29 inches; the minimum of the growing period being only 5.0 inches in 1887. It appeared, therefore, that at the present time, with the drainage areas almost entirely deforested, streams must necessarily be very low during the summer season of nearly every year. Practical observation in Western New York amply confirms this theoretical deduction.

The foregoing data as to summer rainfall show why it is that even fully forested areas are sometimes subject to drought. When the growing period rainfall sinks to 5.0 or 6.0 inches, even a forested area will be dry. The difference is that, in a

large forested area, summer droughts occur only occasionally, while in Western New York, under present conditions of forestation, they occur about every other year. Failure to appreciate just this difference has frequently misled investigators.

I regret that I have already considerably transcended the limits which I set to myself at the beginning of this paper, and can only urge in extenuation that even as it is, I have only been able to give a bare skeleton of the data collected during the last five years. I sincerely hope that I have not specially wearied the Association with the very inadequate presentation of the said data which I am able to make at this time.

EFFECT OF FOREST DENUDATION ON WATER COURSES AND WATER SUPPLY.

By DAN W. BAIRD, Nashville, Tenn.

[Read at Nashville meeting, September, 1897.]

Gentlemen and Ladies of the American Forestry Association: The organization of your Association in the City of Cincinnati in 1882 marks an era of common sense in the conservative development of our great country. It was purely a voluntary organization, inspired by high, patriotic motives, and without any hope or expectation of individual reward. The fact that your organization has grown to be one of National importance, and numbers in its membership the best thinkers of both sexes, is sufficient evidence that its objects are based upon a National need. The incorporation of the Association into a body politic on January 25, 1897, was a move in the right direction, but the limiting clause of twenty years as the life of the corporation is, to my mind, a very short period compared to the time required for forest growth.

* * * * *

The objects of this Association are of far more importance to the future welfare of our country than are set forth in the brief

Articles of Incorporation. The third section, which is the main one, reads as follows:

"That the objects of the organization are the discussion of subjects relating to tree-planting, the conservation, management, and renewal of forests, and the climatic and other influences that affect their welfare; the collection of forest statistics, and the advancement of education, legislative, or other measures tending to the promotion of these objects. It shall especially endeavor to centralize the work done and diffuse the knowledge gained."

Brief as it is, this declaration of the objects of this Association opens up a wide field for scientific investigation, for experiment, a study of forest history, the effects of vast forest areas upon climatic conditions, and upon the character of the people, and many other matters of prime importance to the present and to the future generations.

* * * * *

To carry out its intents and purposes, the American Forestry Association has not only a theory, but many conditions to confront. The theory is that everyone who owns land has a right to dispose of the natural growth on it at any time and in any manner desirable, provided that navigable streams shall not be obstructed. This theory is good in all law courts. About 75 per cent. of all the timber lands in the United States are under private ownership. Neither the Federal nor the State Governments have any control over the forests on private lands. What can this Association do to conserve and preserve existing forests, and to encourage tree-planting? That is the problem now confronting this Association, and as a partial answer this paper is written.

There are only two ways to force people to do their duty. One is through promise of reward, and the other through fear of punishment. Most of our people are good Christians and exemplary citizens, because they love their Lord and want to obey His commandments, and secure the blessings and rewards promised to the finally faithful. We have another set who are equally as devout in their outward devotions, simply because they are afraid of the devil. So, the American Forestry Association, in order to make its work effective, must appeal to the hopes or fears of the land-owners or farmers. It is of no use to

tell them of the rewards or profits they might derive from the planting of trees, although it can be proven that tree plantations, properly managed, will pay an annual profit equal to 2 per cent., and are as safe investments as Government bonds, yet the average land-owner is unwilling to wait. He wants a crop to mature every year. He cuts and burns timber in order to open up new grounds for farm purposes, and never once thinks of the washing rains that fall upon bare soil and carry what is left of its fertility on its winding way to the Gulf of Mexico.

What are we to do with these land-owners in order to induce them to preserve the young forest growth and to plant forest trees? The hope of a reward, as shown, is too remote to act as an incentive to tree-planting or to any painstaking efforts to conserve or preserve whatever may be left of our natural forest growth. Then, what? Scare them?

Well, the facts within the recollection of every citizen of the Central South, over three-score years of age, who has any common sense, and who made anything like accurate observations, is enough to scare anyone who is dependent upon nature for a water supply. In middle Tennessee, fifty years ago, there were "lasting" springs on every farm. Since the timber has been cut off, many of the "lasting" springs have become "wet weather" springs. What were considered well-watered farms now depend upon deep-bored wells for stock water. I speak from my own personal knowledge, and will say that the water level of this country has fallen many feet below what it was before the trees were destroyed. Fifty years ago, when wells were dug with hand tools, the experts that we called "water witches" located subterranean streams never more than thirty-five feet below the surface of the land. Since steam well-boring machinery has come into general use, the forked witch hazel switches "work" for a depth rarely less than sixty feet and generally over one hundred.

It will profit nothing to discuss now the question of the effects of forests on rainfall or climate. Accurate and reliable meteorological observations are of too recent establishment to prove anything of value, but the fact is not denied that the most luxuriant forest growths are found where a large annual rainfall is the rule. Whether the forests produce an increase of rainfall, or whether copious rains produce the forests, is a question

that we have no reliable observations to determine. That forests mitigate the heat of summer and the winds of winter is a settled fact. The blizzards and "northers" of our Western treeless States, that destroy live stock by the thousand head, and often cause loss of human life, would not be possible in a well-wooded country.

There is another fact that no one disputes. Forest growths, while it cannot be proven that they increase the rainfall, certainly serve to retain that which does fall, and thus feed the springs and maintain a better volume of water in the brooks, creeks and rivers, for a greater period of each year. Flowing through the City of Nashville is a beautiful river of water so free of all kinds of sediment that no trouble from scale occurs in steam boilers in which it is used. According to an official report made to Congress some forty years ago, "the Cumberland River is navigable for a greater length in miles, according to its channel capacity, than any other river in the United States." Forty-five years ago big side-wheel steamboats delivered at our wharves sugar, rice and other products from New Orleans; machinery, iron, etc., from Pittsburg, and other Ohio and Mississippi River points. There has not been a New Orleans or a Pittsburg steamboat here for years. The United States Government has now a large force at work building locks and dams to restore the navigable capacity of the river. Today, perhaps, one can, from the State Capitol, see half-grown boys wading the river. The records of the weather service show greater and more destructive floods than formerly. Then here are two facts that cannot be disproved: The timber has been largely cut from the weathershed of the upper Cumberland; disastrous floods in the river are of more frequent occurrence, and the volume of water in its channel during periods of drought is far smaller than forty years ago. These facts cannot be a mere coincidence.

It would seem nothing but right that the class of people who cut off the primeval forest growth should do the re-forestation. It is a mistake to suppose that the lumbermen are wholly responsible for the denudation of the forest lands of the hardwood section of the Central South. The farmers have been cutting down and burning timber for more than a hundred years. The lumber trade of this section scarcely dates back thirty years.

The lumbermen, as a rule, cut only mature trees; the farmers cut everything and burn the stumps.

Speaking for this section of the country, my suggestion to the American Forestry Association is to try to reach the farmer—the small land-owners as well as the large ones—to impress upon him the study and the necessity of taking care of the young forest growth; to plant tree seeds and set out young plants on every available spot of ground not needed for cultivation in farm crops. If the farmers can be induced to read them, and this Association can raise the funds to distribute them, I would suggest the circulation of short, practical articles on the management of young forest growth and tree-planting. A very erroneous impression prevails as to the cost of tree-planting and the length of time required to produce merchantable timber. Of the nut-bearing trees, common to this latitude, it is only necessary to bury the mature nuts a few inches in the ground, keep hogs and cattle away from them a few years, and nature will do the rest. Five years will suffice to produce a profitable crop of hickory hoop poles, and the closer the crop of proper size is cut at the proper season the larger the next year's crop will be. Walnut trees, suitable for newels, balusters, handrails and all kinds of built-up work, can be grown within thirty years.

But, in addressing the farmers on this subject, I would appeal to their fears instead of their hopes. When a field has been robbed of its fertility by careless cropping to the extent that it is no longer profitable to cultivate, it should be planted in some kind of tree growth, or it will wash into gullies beyond the hope of redemption during two generations, and become practically an incumbrance to its inheritors, instead of a means of support. Unless the watersheds of streams are kept shaded by tree growth, the water supply of springs, wells, brooks and creeks will fail during a short drought; the few pools remaining will become stagnant and putrid, and breed disease and death. Forests are necessary to good health. When the cholera or other epidemic disease appears in Southern India, the British Army is immediately ordered to the hilly woodland districts. When the cholera visited this city, everyone who could skipped out to the woodlands. During the present yellow fever scare the residents of the infected districts are making every effort to

get into the woods. Why? Because the most ignorant know that epidemic diseases never rage in a densely wooded country; that the purest water is found in the streams that have their sources in the woodlands.

FORESTS IN IOWA.

By THOMAS H. MACBRIDE, Professor of Botany State University of Iowa.

[Read at Nashville meeting, September, 1897.]

As is well known, Iowa was when first settled essentially a prairie State. There were wooded areas, but these were generally disconnected and limited to particular regions, such as the banks of the perennial streams, clay hills, sandy and rocky ridges. The spread of timber was prevented by prairie-fires. Where the grass was heavy these were excessively hot, so that trees could maintain themselves only where the grass was scanty; that is, where the soil was thin or barren. Moreover, the trees were for the most part scattered. As far as trees were concerned, one could drive or ride anywhere through the primeval woods of Iowa, except, perhaps, immediately along the borders of streams. The greater number of the trees were old; they were low, often scrubby, storm-tossed, often scarred by fire, of little value. In fact, it is believed by some that prior to 1850 the forest in Iowa, such as it was, was actually retreating, dying out, before the stress of fire and storm.

However this may be, it is certain that the coming of civilization by checking prairie fires was for Iowa woodland immediately and greatly advantageous. True, there was immediate demand for lumber and fuel. The earlier laws compelled the settler to fence against all the cattle of the prairie, and the primeval trees furnished his only material. But in those days water power furnished the only energy for driving the saw; mill sites were far apart, and lumber-making was slow. More-

over, in a very few years, Mississippi rafts brought to the shores of Iowa quantities of Minnesota pine, so cheap that it did not pay to cut the native timber, and the primeval oaks obtained unlooked-for respite—a new lease of life. Those that remained availed to furnish seed, and under the new conditions the forest began to spread, and in the twenty-five years succeeding 1850 became totally changed. What was called “second-growth” sprang up everywhere. The old trees were soon completely lost in the crowded ranks of their descendants, which, unvexed by fire, and mutually assistant, grew with amazing rapidity, so that it was a common and true remark among men long resident in the State that there were in Iowa more trees than ever before. The fact before mentioned that the trees were confined to inferior soil tended in the same direction, and the woodlands of Iowa, undisturbed, and reckoned worthless, became more beautiful and valuable every year. Such was the fortunate condition of affairs until a few years ago. From about 1878 on, the rise in the value of agricultural lands, the increased demand for fuel, and, above all, the invention of barbed wire as a cheap and convenient fencing material, all combined to the destruction of all hopes which any may have indulged respecting Iowa forests. The woodlands could be fenced for pasture fields; when the trees were cut off herds of cattle prevented forest renewal. About the same time the rapidly rising price of Minnesota pine reached a point where it once more became profitable to saw native lumber, especially by aid of the portable steam sawmill; so that all the old trees have at last been cut off and sawed up into bridge lumber and railroad ties; and the prospects now are that within a few years every vestige of Iowa woodland will be converted to agricultural use. Much as we deplore the loss of our forest, with all its beneficent influence, with all that it contributes to human weal, the case would not be so utterly bad were it true that the removal of the forest gave place to other valuable harvest. This is, indeed, true in some places. The rich bottom-lands when cleared make in some localities fine farms, and the gentler slopes among the hills of sand and loess make fine blue-grass pastures, but in the vast majority of cases neither of these conditions obtains. The woods cover rocky knolls, sand hills, steep hillsides of yellow clay; in fact, land that is otherwise

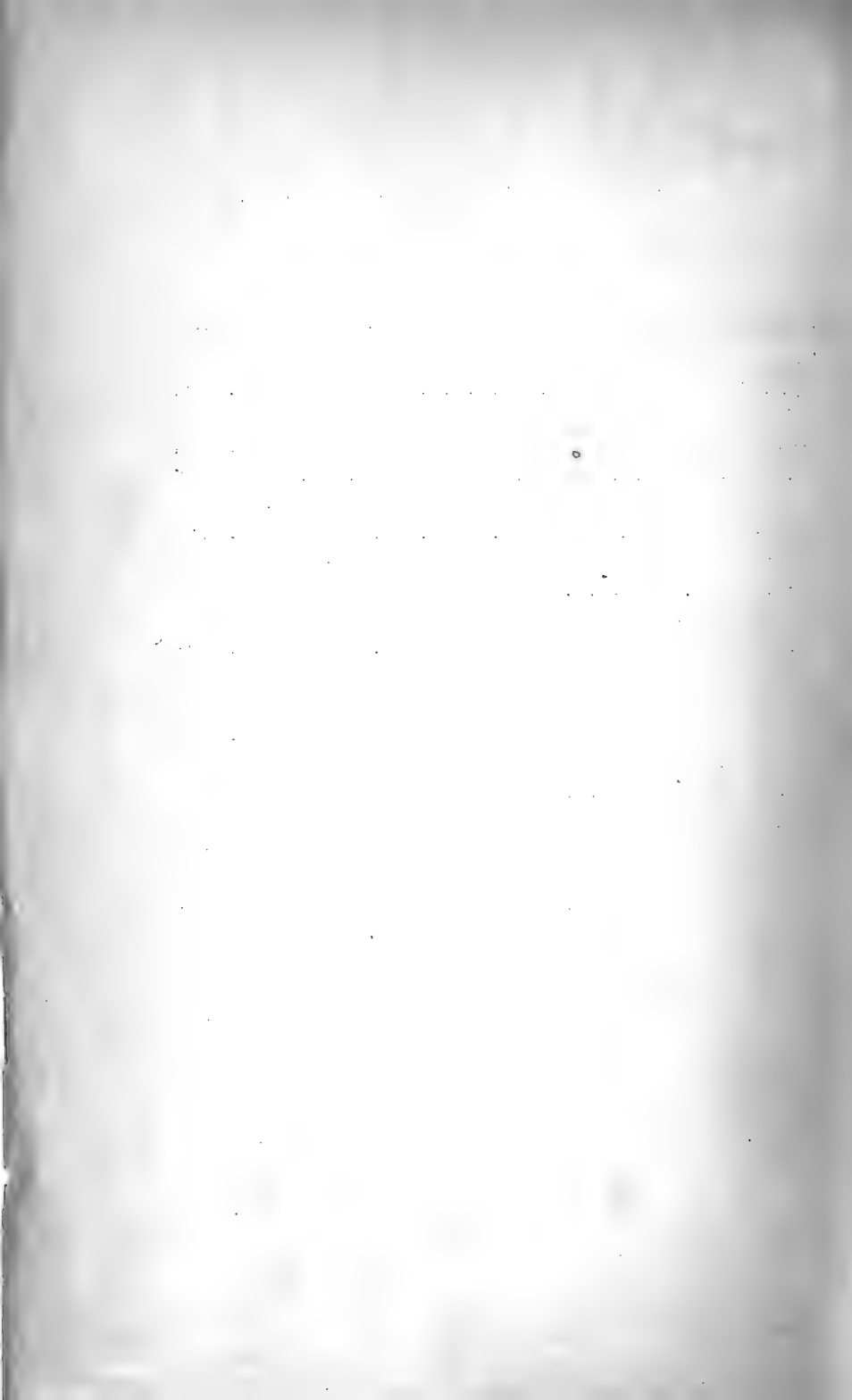
worthless. The thin deposit of rich soil caused by the decay of leaves through long preceding years soon washes off, once the trees are removed, and the land from which the farmer hoped at least grass for his cattle washes after a year or two in gullies, whitens to bare rock, or at most grows up in thistles and weeds that can thrive in the most inhospitable localities. Added to these unfortunate conditions, we must record the fact that the past few years in Iowa have been seasons of remarkable drought—a drought so severe as to destroy, not tillage-crops only, but in some places indigenous vegetation of every description. Even arboreous plants did not escape. Our native forest trees—oaks, hickories, ashes—have been killed in mid-summer, hundreds of them, particularly the “second-growth,” by the general deficiency of moisture. Taken altogether, the prospect for our Iowa woods is discouraging in the extreme. The only hope of preserving any of our primitive forest area lies in the possibility of stirring the intelligent sentiment of our people. This is the more difficult from the fact that Iowans are accustomed to boast that every acre of Iowa land may be made subject to tillage. This, of course, is not true. There are thousands of acres that should never be tilled at all. Nevertheless, there are many men ready to try the experiment, as if to make good the supposedly patriotic boast. If the woods are all swept away, the time will probably soon come when much of the land they cover will be re-forested, but by herculean labor.

As an offset to this somewhat hopeless, or, at least, despondent side of the picture, it may be said that there are today in Iowa thousands upon thousands of groves planted by farmers for the protection and shelter of their homesteads. The groves are generally of comparatively worthless species of trees, but, nevertheless, they keep ever before the minds of our people the necessity and value of trees. Men who have labored hard to eradicate every native oak, hickory, walnut and maple from their premises have afterwards gone to the trouble to set out about their houses soft maples and box-elders! The people mean well, but they are deplorably in need of sound information. It must be said also that there is among intelligent citizens a growing interest in our problem. Men are discussing woodland reservations, rural parks, water-courses and prob-

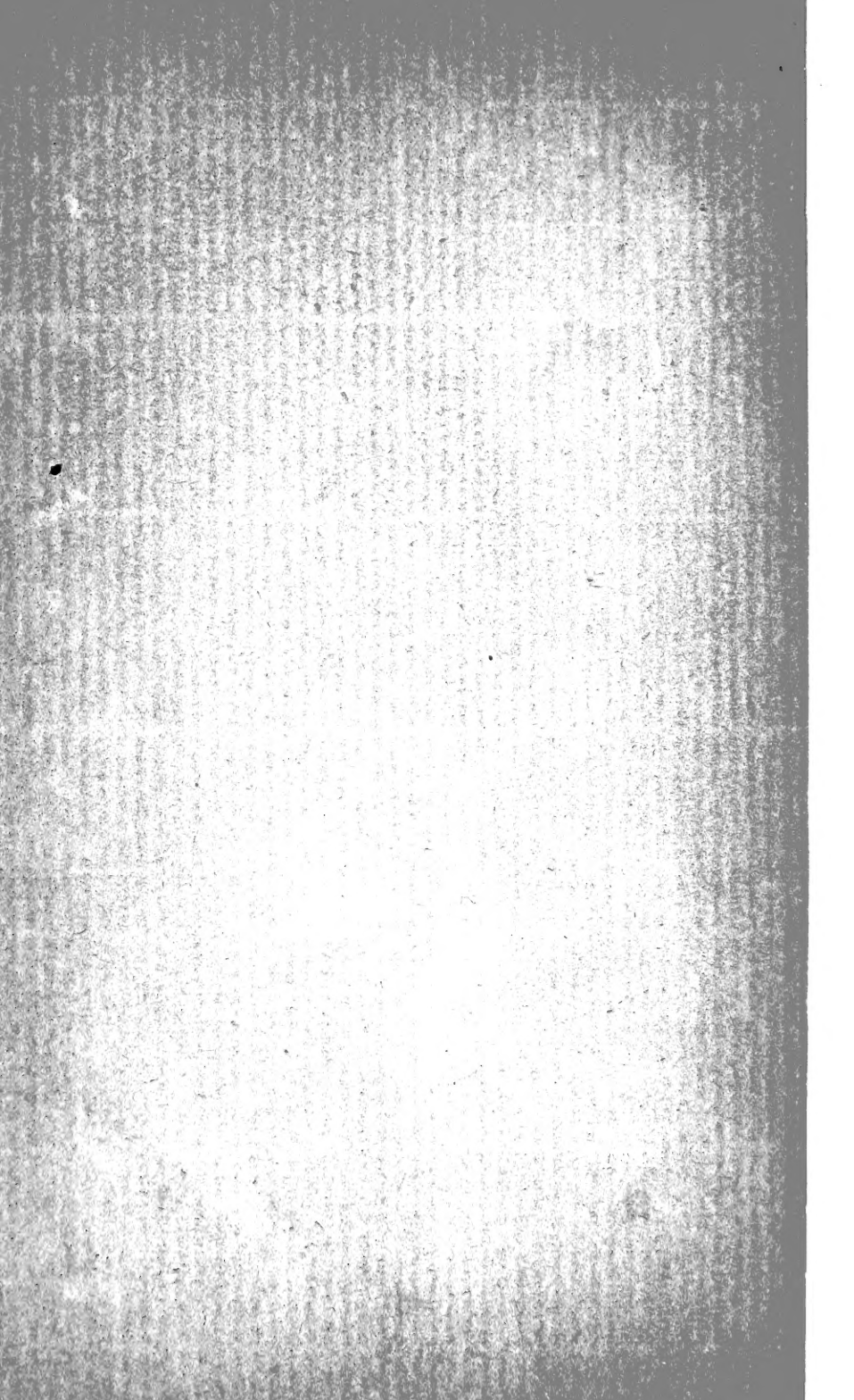
lems of water supply as never before, and there is no doubt that if this interest can be maintained the next decade will show great improvement in public sentiment in Iowa in all that pertains to forest maintenance and preservation.

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